เอกสารอ้างอิง (References)

1. C. Schwecke, Walter Kaminsky, Journal of Polymer Science: Part A: Polymer Chemistry, Vol.39, 2805-2812(2001)
2. Rong Fan, Bo-Geng Li, et.al. Journal of Applied PolymerScience, Vol.85, 2635-2643(2002)
3. Bin Chen, Xiliang Li, et.a., Polymer 43 (2002)953-961
4. Lei Zheng, Rajeswari M. Kasi, et.al., Journal of Polymer Science : Part A: Polymer Chemistry, Vol.40, 885-891(2002)
5. J. Y. Dong, E. Manias, and T.C. Chung, Macromolecules 35, 3439-3447, 2002
6. F. Picchioni, M. Aglietto, et.al., Polymer 43 (2002)3323-3329
7. Won-Mook Choi, C. Park, et.at. Journal of Applied Polymer Science, Vol.85, 2084-2091(2002)
8. F. Chiu, K. Shen., et.al., Polymer Engineering and Science, May 2001, Vol. 41m, No.5
9. C. Wang, Y.-C. Hsu, C.-F. Lo, Polymer 42 (2001) 8447-8460
10. K. Hodge, T. Prodpran, et.al., Journal of Applied Polymer Science, Vol.83, 2705-2715(2002)
11. Q. Chen, Y. Yu, et.al., Journal of Applied Polymer Science, Vol.83, 2528-2538(2002)
12. K. Tashiro, Akiko Yoshioka, Macromolecules 35, 410-414, 2002
13. D. Amutha Rani, Y. Yamamoto, et.al., Journal of Polymer Science: Part B: Polymer Physics, Vol.40, 530-536(2002)
14. Y. Li, J. He, et.at., Polymer 43 (2002) 2489-2494
15. R. D. Sudduth, Pavan K. Yarala, Polymer Engineering and Science, April 2002, Vol.42, No,.4
16. Chi Wang, Yong-Wen Cheng, et.al., Journal of Polymer Science: Part B:Polymer Physics, Vol.40, 1626-1636(2002)
17. Paola Rizzo, M. Lamberti, et.al., Macromolecules 35, 5854-5860, 2002
18. F.C. Chiu, C.G. Peng, Polymer 43, 4879-4886, (2002)
19. A.Buckley, A.B.Conciatori and G.W.Calundann, U.S.Patent 4,434,262, 1984
20. A.Siegmann, A.Dagan and S.Kenig, Polymer, 26,1325-1330, (1985)

21. Y.C.Lin, H.W.Lee and H.H.Winter, Polymer, 34, 4703-4709, 1993

22. อัญชนา ชื่นเชาว์กิจ, วิทยานิพนธ์มหาบัณฑิต, สาขาวิศวกรรมเคมี,
จุฬาลงกรณ์มหาวิทยาลัย, 1998

23. สุรพันธ์ โปวอนุสรณ์, วิทยานิพนธ์มหาบัณฑิต, สาขาวิศวกรรมเคมี,
จุฬาลงกรณ์มหาวิทยาลัย, 2000

24. นพวรรณ โม้ทอง, วิทยานิพนธ์มหาบัณฑิต, สาขาวิศวกรรมเคมี,
จุฬาลงกรณ์มหาวิทยาลัย, 2002

25. สุภลักษณ์ คุณประเสริฐ, วิทยานิพนธ์มหาบัณฑิต, สาขาวิศวกรรมเคมี,
จุฬาลงกรณ์มหาวิทยาลัย, 2002

26. S.Wacharawichanant, S.Thongyai, S.Tanodekaew, J.S.Higgins and N.Clarke
Polymer, 45, 2201-2209, 2004

27. M.Sivakumar, T.Suzuki, Y.Yamamoto,K.P.O. Mahesh, H.Yoshimizu,
Y.Tsujita, Journal of Membrane science 238, 75-81, 2004

28. Y.Qian, H.Zhang, J.Zhou, W.Zhao, X.Sun, J.Huang
Journal of Molecular Catalysis A: Chemical 208 , 45–54, (2004)

29. S.C.Wu, F.C.Chang, Polymer 45, 733–738, (2004)

30. X.Sun, J.Xie, H.Zhang, J.Huang, European Polymer Journal 40, 1903–1908, (2004)

31. C.Wang, C.C.Chen, C.H.Hung, K.S.Lin, Polymer 45, 1-9, (2004)

32. S.K.Noh, S.Kim, Y.Yang,W.S.Lyoo, D.H.Lee,
European Polymer Journal 40, 227–235, (2004)

33. Y.Y.Lyu, Y.Byun, J.H.Yim, S.Chang, S.Y.Lee, L.S.Pu, I.M.Lee
European Polymer Journal 40, 1051–1056, (2004)

34. D.Larobina, L.Sanguigno, V.Venditto, G.Guerra, G.Mensitieri,
Polymer 45 (2004) 429–436

35. K.Beckerle, C.Capacchione, H.Ebeling, R.Manivannan, R.Mulhaupt, A.Proto,
T.P.Spaniol, J.Okuda, Journal of Organometallic Chemistry (2004)

36. C.Capacchione, A.Proto, H.Ebeling, R.Mülhaupt,K.Möller,
R.Manivannan, T.P.Spaniol, J.Okuda,
Journal of Molecular Catalysis A: Chemical 213, 137–140, (2004)

37. A.K.Ghosh, E.M.Woo, Polymer 45, 4749–4759, (2004)

38. J.Schellenberg, European Polymer Journal 40, 2259–2267, (2004)

39. Y.Uda, F.Kaneko, T.Kawaguchi, Polymer 45, 2221–2229, (2004)

40. C.I.Park, M.H.Kim, O.O.Park, Polymer 45, 1267–1273, (2004)

41. M.Giordano, M.Russo, A.Cusano, G.Mensitieri, G.Guerra,
Sensors and Actuators B (2004)

42. C.Wang, W.P.Liao, M.L.Wang, C.C.Lin, Polymer 45, 973–981, (2004)

43. C.Wang, W.P.Liao, Y.W.Cheng, T.L.Lin, Polymer 45, 961–971, (2004)

ผลงานตีพิมพ์ที่ได้จากงานวิจัย

Effect of Low Molar Mass Liquid Crystal and Lubricant on Miscibility and Thermal Properties of Syndiotactic Polystyrene Blends

Pichet Pahupongsab,[1] Supakanok Thongyai,[1] Sirirat Wacharawichanant,[2] Piyasan Praserthdam[1]

[1]*Department of Chemical Engineering, Faculty of Engineering, Center of Excellence on Catalysis and Catalytic Reaction Engineering, Chulalongkorn University, Bangkok 10330, Thailand*
[2]*Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakorn Pathom 73000, Thailand*

Received 15 April 2008; accepted 11 May 2009
DOI 10.1002/app.30751
Published online 30 June 2009 in Wiley InterScience (www.interscience.wiley.com).

ABSTRACT: This research concerned with the miscibility and thermal properties of syndiotactic polystyrene (SPS) blended with several polymers such as poly(α-methyl styrene)—PaMS, poly(ethyl methacrylate)—PEMA, poly(*n*-butyl methacrylate)—PBMA, poly(cyclohexyl acrylate)—PCHA, and poly(*cis*-isoprene)—PIP. The SPS synthesized by using metallocene catalyst and modified-methylaluminoxane (MMAO) as cocatalyst. From the experimental results, it was found that the SPS can be miscible with PaMS, PEMA, PBMA, PCHA, and PIP. Furthermore, the effects of the addition of low molar mass liquid crystal (cyclohexyl-biphenyl-cyclohexane, CBC33) and lubricant (glycerol monostearate, GMS) on thermal properties of the blended polymers with SPS are concerned. Both CBC33 and GMS can lower the crystallization temperature (T_c) of the blend and can also slightly lower the melting temperature (T_m) of the blends. This might be because of the higher mobility of SPS molecules induced the separation from the crystal both in the case of the depression of T_c or T_m. The higher mobility of the blends happened together with the further reduction of the melt viscosity of the blends according to CBC33 that can be proven by Motong et al. in 2008 (Motong et al., J Appl Polym Sci 2008, 107, 1108). © 2009 Wiley Periodicals, Inc. J Appl Polym Sci 114: 2053–2059, 2009

Key words: miscibility; thermal properties; syndiotactic polystyrene; liquid crystal; lubricant

INTRODUCTION

Generally, polystyrene (PS) is one of the most important commodity polymers in the industry. Its applications range from high modulus, transparent grade to rubber modified, tough resins and blends with outstanding impact resistance and mechanical properties. Recently, coordination polymerization techniques were introduced for preparation of new polystyrene, which has an entirely new range of possibilities and the feasibility for preparation of a highly stereoregular, syndiotactic polystyrene (SPS) was demonstrated.[1] SPS prepared by coordination polymerization is a new semicrystalline thermoplastic material with high crystalline melting temperature (270°C) and excellent chemical resistance. However, because SPS has some economic disadvantages such as low strength at low temperature,[2] higher processing temperature,[3] and low efficiency of polymerization catalyst, it has been restricted to a few applications. So, many researchers are still interested in blending SPS with secondary polymer materials and in the miscibility of its polymer blends.

The previous researches have studied the miscibility of polystyrene with several polymers, viz. polyphenyleneether (PPE), polyvinylmethylether (PVME), poly-2-chlorostyrene (PCS), polymethylstyrene (PMS), polycarbonate of tetramethyl bisphenal-A (TMPC), polycyclohexyl acrylate (PCHA), polyethylmethacrylate (PEMA), polycyclohexyl methacrylate (PCHMA) and etc.[4] Widmaier and Mignard[5] investigated the blends of PS of molecular weights from 4000 to 80,000 g/mol to poly(α-methylstyrene) of molecular weights from 55,000 to 300,000 g/mol by freeze-drying from benzene solutions. Glass transition temperature (T_g) measurements by differential scanning calorimetry (DSC) indicate that the miscibility behavior of the polymers is very sensitive to change of molecular weights. A decrease in PS chain length changes a two-phase system into a miscible or partially miscible blend. Cimmino et al.[6,7] investigated the dependence of miscibility on composition and temperature in SPS/PVME blends by means of

Correspondence to: S. Wacharawichanant (iamsirirat@yahoo.com).
Contract grant sponsor: Graduated School of Chulalongkorn University.

solid-state NMR and DSC. The DSC experiments showed two T_g values corresponding to an SPS-rich phase (83 : 17 wt %) and a PVME- rich phase (13 : 87 wt %). For SPS/PPE blends, DSC and DMTA measurements give an intermediate single T_g value[8–11] between those of the pure components and obviously depended on the compositions. The T_g values of SPS and PPE are much different from each other (98 and 220°C, respectively), and this result constitutes an unambiguous proof of the blend miscibility within the whole composition range.

However, the excellent properties of polymer can become a cause of limitation in manufacturing processes especially the viscosity of melted polymers. The polymer blending procedure requires many complicated operations involving high temperature and high shear rate; therefore, their processing and manufacturing of polymer blends usually consume high energy. The processing properties of polymer blends can be modified by adding various additives, such as antioxidants, plasticizers, and others. Many additives can reduce melt viscosity of polymers to improve their processability, but most additives may cause many negative effects to important properties of polymers, especially the mechanical properties of the final products. Lubricant,[12] a small quantity polymers' additive, can provide a considerable decrease in resistance to the movement of chains or segments of amorphous polymer or at least partly amorphous structure. Low molar mass liquid crystals (LMMLCs) were also found to improve processability of polymers.[13,14] Patwardhan and Belfiore reported that addition of LMMLC to amorphous polymers could improve both processability and mechanical properties of the blends.[15] The addition of low molar mass liquid crystal (CBC33) can dramatically reduce the melt viscosity of polycarbonate as observed by the rheometer.[13]

This work investigates the miscibility and thermal properties of SPS, which synthesized by homogeneous half-metallocene catalyst system, blended with various polymers, and of these SPS blended properties after addition of low molar mass liquid crystal (CBC33) and lubricant (GMS).

EXPERIMENTAL

Materials

Styrene monomer purchased from Fluka Chemie A.G. was distilled from sodium under vacuum just before use. Trichloro(pentamethyl cyclopentadienyl) titanium (IV) (Cp*TiCl3, 97.0%) was purchased from Aldrich. Modified methyaluminoxane (MMAO) 1.831 *M* in toluene was donated from Tosoh Akso, Japan. The low molar mass liquid crystal (LMMLC), CBC33, was purchased from Merck Co., Ltd. in the form of a white powder. The CBC33 structures that contain a cyclohexyl-biphenyl-cyclohexane backbone can be shown as Figure 1. Its molecular weight characteristics, transition temperatures, and other physical properties can be shown in Table I. The lubricant, glycerol monostearate (GMS), was kindly provided by Rikevita Ltd (Malasia) with the melting point of 65°C and the molecular weight of 358 g/mol. The chemical structure of GMS can be shown in Figure 2.

Poly(*n*-butyl methacrylate)—PBMA, poly(α-methyl styrene)—PaMS, poly(cyclohexyl acrylate)—PCHA, poly(cyclohexyl methacrylate)—PCHMA, poly(*cis*-isoprene)—PIP, poly(ethyl methacrylate)—PEMA were purchased from Scientific Polymer Products, Inc and used as received.

TABLE I
Properties of Low Molar Mass Thermotropic Liquid crystals

Property	CBC33
Melting point (°C)	158
Smectic-nematic temperature (°C)	223
Clearing temperature (°C)	327
Molecular weight (g/mol)	403

Polymerization procedure

Cp*TiCl3 (~ 0.014 g) was stirred in 35 mL of toluene under argon atmosphere until dissolved. Styrene monomer (chemical reagent grade) was washed with 5% aqueous sodium hydroxide (NaOH) solution and distilled water, then distilled under reduced pressure.

Polymerization of styrene was carried out in a 250 cm^3 glass reactor equipped with a magnetic stirrer by introducing 46 mL of toluene, 32 mL of Cp^*TiCl_3 dissolved in toluene, 13.6 mL of MMAO and 28.4 mL of styrene at the desired temperature of 25°C under argon atmosphere. The total volume of the polymerization mixture was 120 mL. The addition of styrene was regarded as the starting point of the polymerization reaction. After complete the

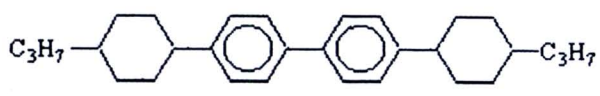


Figure 1 Structure of CBC33.

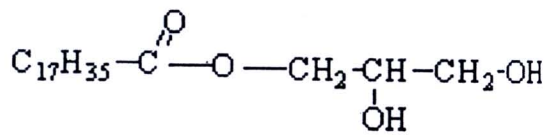


Figure 2 Structure of glycerol monostearate (GMS).

TABLE II
Polymerization of Styrene Using Cp^*TiCl_3 with MMAO[a]

% Yield[b]	72.67 wt %
Catalytic activity	5084.67 g PS/mmole Ti·hr
% Syndiotactic index	93.38 %
M_w[c]	1,943,500 g/mol
M_n[c]	592,300 g/mol
Molecular weight distribution (MWD)[c]	3.3
T_g[d]	97.90°C
T_m[d]	271.41°C

[a] Conditions: $[Cp^*TiCl_3] = 3.68 \times 10^{-4}M$, [MMAO] = 1.83 M, [Styrene] = 2.06, Al/Ti = 563, 25°C.
[b] Calculated from (weight of synthesized polymer/weight of monomer) × 100.
[c] Obtained from GPC and MWD was calculated from M_w/M_n.
[d] Obtained from DSC.

desired reaction time, the reactions were terminated by the addition methanol followed by 10% HCl in methanol. The precipitated polymer was washed several times with methanol and dried at room temperature. The polymer obtained was extracted with refluxing methyl ethyl ketone (MEK) for 12 h to isolate the SPS portion of the polymer obtained from other isomers.

Soxhlet extractor was used for syndiotactic content determination. The obtain polystyrene was extracted with boiling methyl ethyl ketone (MEK) or 2-butanone to give syndiotactic (insoluble) and atactic/isotactic (soluble) polystyrene. A % syndiotactic index (% S.I.) is computed from

$$\% \text{ S.I.} = \frac{\text{Insoluble Weight of PS}}{\text{Total Weight of PS}} \times 100 \qquad (1)$$

The melting temperature (T_m) and T_g values of the polymers were determined by a Perkin-Elmer DSC-Diamond. The analyses were performed at the heating rate of 20°C/min in the temperature range 50–300°C. The molecular weight (M_w) and molecular weight distribution (MWD) were investigated by gel permeation chromatography (GPC). Samples were prepared accurately at a concentration of approximately 0.5–1.0 mg/mL in the mobile phase and dissolved by using the PL-SP 260 at a temperature of 150°C for, approximately, an hour. The dissolved sampled were transferred into PL-GPC 220. The GPC measurement was performed at Thai Petrochemical Industry Public Co., Ltd.

Polymer blend preparation and characterization

The blends of SPS/polymers and their blends with, CBC33, the liquid crystal or, GMS, the lubricant were prepared by mechanical mixing using a digital hot plate at various compositions. The SPS/polymers were mixed together with CBC33 or GMS at 310°C, and all the blended samples were kept at 300°C for 5 minutes before immediately quenched to 200°C and held for 20 minutes, before further cooled down to room temperature. The melting temperature (T_m), the crystallization temperature (T_c) and the glass transition temperature (T_g) of the blends were determined by a Perkin-Elmer DSC-Diamond. The analyses were performed at the heating rate of 20°C/min in the temperature range 50–300°C.

RESULTS AND DISCUSSION

Polymerization of styrene

The results of the polymerization of styrene, using Pentamethylcyclopentadienyl titanium trichloride (Cp^*TiCl_3) with modified-methylaluminoxane (MMAO) as cocatalyst, can be summarized as in Table II.

Effect of LMMLC and lubricant on thermal properties of polymer blends

Glass transition temperature

The glass transition temperature is the characteristic of the amorphous part of the polymers. At T_g, a dramatic change occurs in the local movement of molecule level of polymer chain from glassy state to rubbery state, which this changes almost all of the physical and mechanical properties of polymer.[16]

The miscibility of binary blends is frequently ascertained by measurements of their T_g. Figure 3 shows T_g of each composition of SPS/PaMS blend. It is observed that the T_g of pure SPS and PaMS is 97.90 and 87.33°C, respectively. All the blends with different compositions exhibit single T_g which shifted to a higher temperatures in the same trend as the SPS content in the samples. This result may imply the miscibility of the two components in the blends under the DSC condition. The thermal

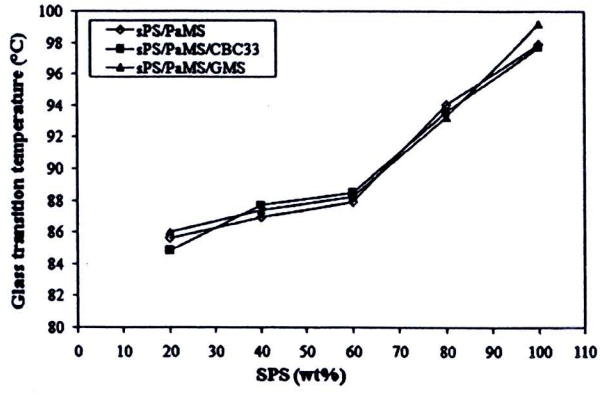


Figure 3 Glass transition temperature of SPS/PaMS blends before and after adding CBC33 and GMS.

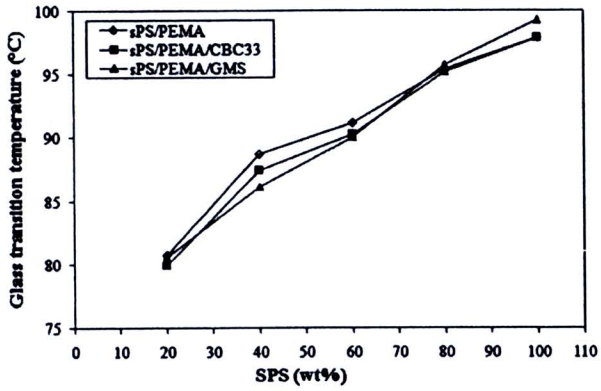


Figure 4 Glass transition temperature SPS/PEMA blends before and after adding CBC33 and GMS.

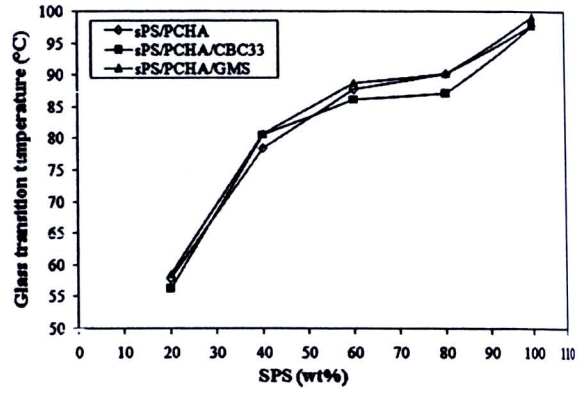


Figure 6 Glass transition temperature SPS/PCHA blends before and after adding CBC33 and GMS.

characteristics of SPS/PaMS/CBC33 blends and SPS/PaMS/GMS blends are shown that T_g of binary blends are in the same vicinity of their blends with CBC33 and GMS. The difference between T_g of binary blends and their blends with additives are less than 1°C, and cannot be distinguished from each other. These phenomena may be resulted from the too small (1.0% w/w) amount of additives in the matrix phase of the binary blends that are not enough to plasticize the blends to such an extent that the significant reducing in T_g of the blends can be observed.

Figures 4–7 show T_g of each composition of SPS/PEMA, SPS/PBMA, SPS/PCHA, SPS/PIP blend. It is observed that all the blends with different compositions exhibit single T_g, which shifts to a higher temperature with the SPS content. This result may imply that the miscibility of the two components in the amorphous state of the blends. The values of T_g of binary blends are in the same vicinity to their blends with CBC33 and GMS. Thus, the additions of CBC33 and GMS have not significantly affected T_g of binary blends as same as SPS/PaMS blends.

From these results, it was found that the SPS have tendency to be miscible with PaMS, PEMA, PBMA, PCHA, and PIP by melt mixing method. The glass transition temperatures of all the blends with additives do not significantly change from additive less binary blends. This phenomenon proves that additives do not have significant direct plasticizing effects on glass transition temperature of pure binary blends when added in the small quantity.

Crystallization temperature

The crystallization temperature is the temperature that the sPS in the blends started to crystallize due to lower temperature from the cooling ramp rate in DSC. From Figure 8, when the crystallization temperature at cooling rate of 20°C/min (T_c) of SPS/PaMS blends and their blends with additives were compared, they can be showed that addition of CBC33 have affected in the slightly increasing T_c of their blends in the amount of less than 3°C apart from the pure blend. These differences were located

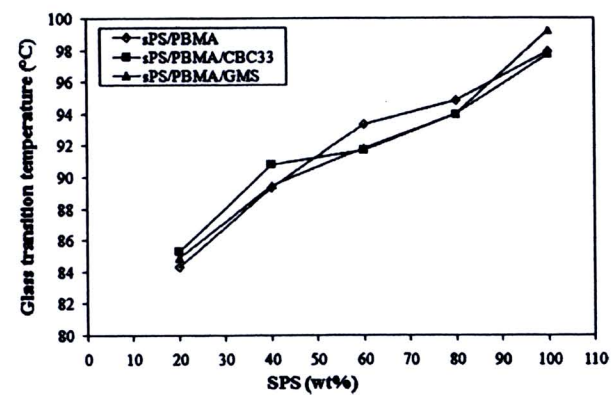


Figure 5 Glass transition temperature SPS/PBMA blends before and after adding CBC33 and GMS.

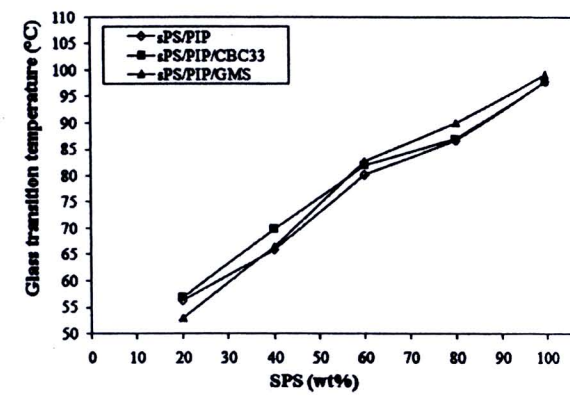


Figure 7 Glass transition temperature SPS/PIP blends before and after adding CBC33 and GMS.

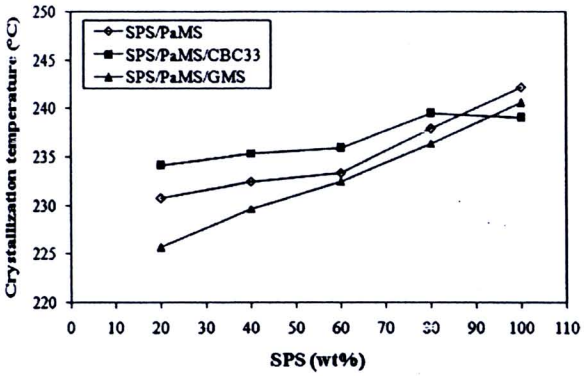


Figure 8 Crystallization temperature of SPS/PaMS blends before and after adding CBC33 and GMS.

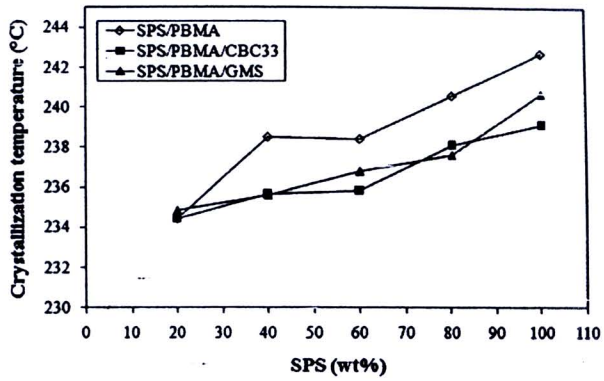


Figure 10 Crystallization temperature of SPS/PBMA blends before and after adding CBC33 and GMS.

in error limit of the DSC that is less than ±5°C apart from each other. But the addition of GMS has the adverse affected by slightly decreasing the T_c of their blends in the vicinity of less than 3°C apart from the pure blend. These differences still were in the error limit of the DSC, and the increases/decreases were not significant while the concentration of the blend changed. So, in the system of SPS/PaMS, the additives (CBC33, GMS) of the small amount in the SPS/PaMS blend were not changed significantly the crystallization temperatures of the blend. This might be because of too similar molecular structures between the SPS and PaMS.

From Figure 9, it can be seen that the addition of CBC33 in SPS/PEMA blends affected the decreasing of T_c in their blends about 4–11°C from pure blend without CBC33. The addition of GMS also affected the decreasing T_c of their blends about 2–10°C. These temperature differences were significant and we can draw the conclusion that the additives tend to significantly decrease the T_c of SPS/PEMA blends, regarded the small amount of the additive.

For SPS/PBMA blends, the additions of CBC33 or GMS have affected in decreasing of T_c in their blends about 3°C apart from the pure blend T_c as shown in Figure 10. Although the decreases of T_c were in the error limit of the DSC, but the unanimous decreases in T_c implied the significant variations. Thus, the additions of CBC33 or GMS have significant trended in decreasing the T_c of SPS/PBMA blends, regarded the small amount of the additive.

Figure 11 shows the values of T_c of SPS/PCHA blends before and after addition of CBC33 or GMS. It can be concluded that the additions of CBC33 or GMS have affected in decreasing of T_c of the blends about 2–5°C from the pure blend. Thus, both additives have significant effects in decreasing the T_c of SPS/PCHA blends, regarded the small amount of the additive.

Similarly, for SPS/PIP blends, the addition of CBC33 or GMS have affected significantly in decreasing of T_c of the blends about 2–7°C from the pure blend as shown in Figure 12. Thus, both additives also have significant effects in decreasing the T_c of SPS/PIP blends from the pure blend, regarded the small amount of the additive.

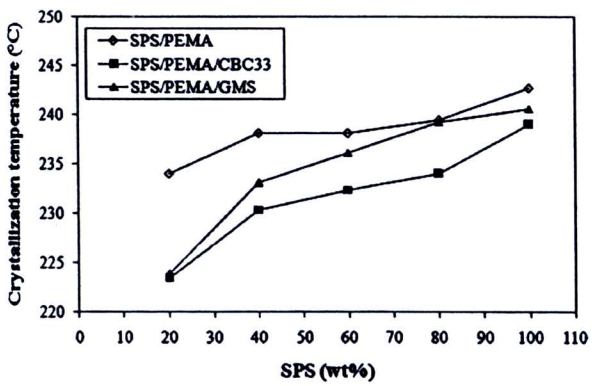


Figure 9 Crystallization temperature of SPS/PEMA blends before and after adding CBC33 and GMS.

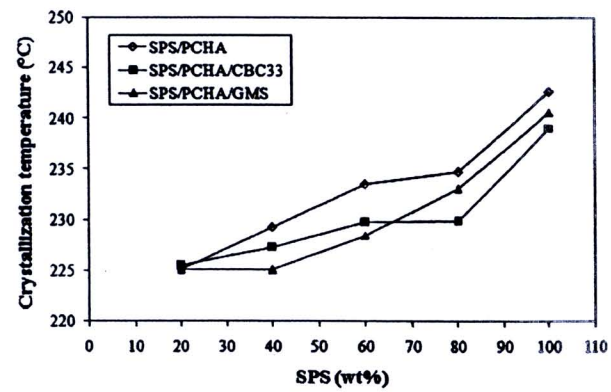


Figure 11 Crystallization temperature of SPS/PCHA blends before and after adding CBC33 and GMS.

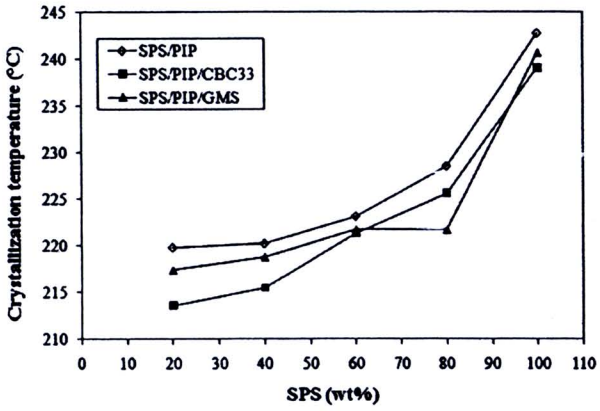


Figure 12 Crystallization temperature of SPS/PIP blends before and after adding CBC33 and GMS.

To summarize from these results, the effects of adding CBC33 or GMS resulted in the significantly slightly decreasing T_c of the polymer blends concerned except the blend with PaMS. These might be because CBC33 and GMS can reduce melt viscosity of the blends,[13,17] so the molecules of the polymers in the blend could move or separate easily. Therefore, the mobile SPS molecules have more difficulty to form the crystal from the induced of cooling temperature, because more mobile SPS molecules may tend to move apart from the order (crystal). The crystalline temperature will decrease according to the mobility of the molecules when added the CBC33 or the GMS due to the less order of the easily mobile chain molecules.

Melting temperature

For polymer blends, the depression phenomenon of the crystalline melting point temperature (T_m) usually happened from the lower of the blends' Gibbs free energy. From Figure 13, the crystalline melting temperature T_m of the pure binary blends and their blends with additives have unanimous lowering tendency than the T_m of the pure component of SPS, although the decreases were in the error limit of the DSC. The decreases were more pronounced with the additions of CBC33 or GMS which the T_m of the addition blends were unanimously and slightly lower than the T_m of the pure blends. In every systems concerned in this research, the crystalline melting points when added the CBC33 or GMS were lowered than the pure polymer blend. From melting point depression phenomenon, the crystalline melting point will be lower if the additives were added to the pure blends. However, because of the small amount of the CBC33 or GMS added, the quantities of the crystalline melting point depression will not only come from the melting point depression phenomenon alone but also contribute from the addition of the CBC33. The decreasing in the crystalline melting point due to the addition of small molecule can be calculated from the equation below,[18]

$$\frac{1}{T_m} - \frac{1}{T_m^0} = -\frac{R}{\Delta H_f} \ln X_A \qquad (2)$$

where, ΔH_f represents the molar enthalpy of the fusion from the SPS crystal. To a first approximation, the melting point depression depends on the mole fraction of impurity (X_B) and the mole fraction of crystallizable polymer (being X_A). For polymer blends, the crystalline melting temperature depression phenomenon that results from the lower of the blend Gibbs free energy needed to have the large amount of X_B to overcome the effect from the molar enthalpy of the fusion. Thus, by this equation, the crystalline melting temperature of the binary blends and their blends with very small amount of additives will have very slightly tendency to lower the temperature from the pure component of the polymers. However, in this research, the effects in lowering the crystalline melting point (T_m) might also come from the contribution from the addition of the CBC33 more than the melting point depression by normal additive. These might be because of the molecular mobility enhancement from both CBC33 and GMS,[13,17] the crystal of the blends will melt easier. The more mobile SPS molecules can slide and depart from each other easier than the blend's SPS molecules without additive; therefore, the crystal will melt easier than the polymer blend without the additive. Moreover, as we have concluded before, the ease of the moving of the SPS molecules may enhance the depression in the crystalline temperature (T_c). By the same assumption, the systems will also have the tendency to be apart from the shape of the crystal (melting of the crystal) faster than the

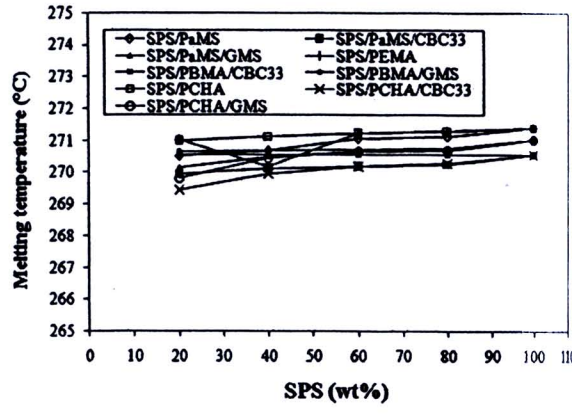


Figure 13 Melting temperature depression of their blends.

normal pure SPS molecules in the normal blend, so the T_m will be lower than usual.

CONCLUSIONS

In this research, the miscibility and thermal properties of SPS blended with several polymers such as PaMS, PEMA, PBMA, PCHA, and PIP were investigated. The SPS was synthesized by using metallocene catalyst. From DSC, it was found that the SPS have tendency to miscible with PaMS, PEMA, PBMA, PCHA and PIP by melt mixing method. The glass transition temperatures of all the blends with additives do not significantly change from non additive binary blends. This phenomenon proves that additives do not have direct plasticizing effects on glass transition temperature of pure binary blends, regarded the small amount of additives.

Both CBC33 and GMS significantly decrease the crystallization temperature (T_c) of polymer blends. Because CBC33 and GMS reduce melt viscosity of the blends,[13,17] the polymers' molecules could move or separate easily. The SPS in the blends might subject to more difficulty to ally their molecules in the shape of the crystal from the fast mobility melt of the polymer blends when added CBC33 or GMS. Therefore, when mobile melt molecule tends to form the crystal, it will hardly form the crystal in case of GMS and CBC33 addition in the blend. Thus, the ease of the moving of the molecule will enhance the depression in the crystalline temperature.

The CBC33 and GMS slightly decrease crystalline melting temperature (T_m) of their blends. By the same assumption, because CBC33 and GMS reduced melt viscosity of the blends, crystal of the blends will melt easier. In other words, the T_m tends to decrease when added with GMS or CBC33 because of the effects from the mobility of the molecules. It can be concluded that the effects of lowering the crystalline melting point largely come from the contribution from the addition of the small amount of CBC33 more than the normal melting point depression by normal additive.

The authors would like to thank Tosoh Akso, Japan for the MMAO.

References

1. Ishihara, N.; Kuramoto, M.; Uoi, M. Macromolecules 1998, 21, 3356.
2. Candi, F. D.; Romano, G.; Russo, R.; Vittoria, V. Colloid Polym Sci 1990, 268, 720.
3. Cimmino, S.; Di Pace, E.; Martuscelli, E.; Silvestre, C. Polymer 1991, 32, 1080.
4. Utracki, L. A. Polymer Blends Handbook; Kluwer Academic Publishers: London, 2002; vol. 1.
5. Widmaier, J. M.; Mignard, G. Eur Polym J 1987, 23, 989.
6. Cimmino, S.; Di Pace, E.; Martuscelli, E.; Silvestre, C. Polymer 1993, 34, 2799.
7. Cimmino, S.; Di Pace, E.; Martuscelli, E.; Silvestre, C.; Rice, D. M.; Karasz, F. E. Polymer 1993, 34, 214.
8. Guerra, G.; Vitagliano, V. M.; De Rosa, C.; Petraccone, V.; Corradini, P. J Polym Sci Part B: Polym Phys 1991, 29, 265.
9. Choi, S. H.; Cho, I.; Kim, K. U. Polym J 1999, 31, 828.
10. Li, H.; Li, G.; Yang, W.; Shen, J. Polym Prepr Am Chem Soc Div Polym Chem 1998, 39, 689.
11. Hong, B. K.; Jo, W. H.; Lee, S. C.; Kim, J. Polymer 1998, 39, 1793.
12. Lutz, J. T.; Grossman, R. F. Polymer Modifiers and Additives; Marcel Dekker: New York, 2001.
13. Motong, N.; Thongyai, S.; Clarke, N. J Appl Polym Sci 2008, 107, 1108.
14. Mothong, N.; Clarke, N.; Thompson, R. L.; Collins, S. A.; Thongyai, S. J Polym Sci Part B: Polym Phys 2007, 45, 2187.
15. Patwardhan, A. A.; Belfiore, L. A. Polym Eng Sci 1988, 28, 916.
16. Brandrup, J.; Immergut, E. H. Polymer Handbook; 3rd ed.; John Wiley & Sons: New York, 1989.
17. Wacharawichanant, S.; Thongyai, S.; Tanodekaew, S.; Higgins, J. S.; Clarke, N. Polymer 2004, 45, 2201.
18. Sperling, L. H. Introduction to Physical Polymer Science; Wiley-Interscience: New Jersey, 2006.

ISSN 0965-545X, Polymer Science, Ser. A, 2010, Vol. 52, No. 3, pp. 279–287. © Pleiades Publishing, Ltd., 2010.

The Crystallinity and Miscibility of Syndiotactic Polystyrene Blends after Mixing with Low Molar Mass Liquid Crystal or Commercial Lubricant[1]

Pichet Pahupongsab[a], Supakanok Thongyai[a], Sirirat Wacharawichanant[b], and Piyasan Prasertdham[a]

[a] *Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand*

[b] *Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakorn Pathom 73000, Thailand*

e-mail: iamsirirat@yahoo.com

Received October 11, 2008;
in final form, February 18, 2009

Abstract—The quantities of the crystallinity of syndiotactic polystyrene (SPS) blended with another polymer in the group of poly(α-methyl styrene), poly(*n*-butyl methacrylate) or poly(cyclohexyl acrylate) with or without the additives were measured by X-ray diffraction and calculated by Ruland's method. The SPS was synthesized by using metallocene catalyst and modified-methylaluminoxane as cocatalyst. The additive of low molar mass liquid crystal chemical (cyclohexyl–biphenyl–cyclohexane (CBC33)) or lubricant (glycerol monostearate (GMS)) was individually added to the blends of SPS in order to investigate the effects on the crystallinity of the blended SPS. From the experimental results, it was found that the percent crystallinities of the blends decreased with decreasing the percent of SPS in the blend because of the dilution of SPS. The depression of the percent crystallinity was in the order of PaMS > PCHA > PBMA according to the compatibility with SPS. The addition of GMS or CBC33 slightly decreased the percent crystallinity of the pure SPS. The addition of GMS impeded the depression of the SPS crystallinity in the blends, because their percent depression from pure SPS is similar (at around 25%) regardless to the components of the blends. The blends with added CBC33 have the similar depression of crystallinity as the pure blends because of the low concentration of CBC33 and the good compatibility of CBC33 with the SPS.

DOI: 10.1134/S0965545X10030090

1. INTRODUCTION

Syndiotactic polystyrene (SPS) is a semi-crystalline polymer synthesized from styrene monomer using a metallocene catalyst [1–4]. The syndiotacticity of SPS results from the homogeneous coordinative polymerization mechanism. Typically, group 4 transition metal complexes are utilized with co-catalysts such as methylaluminoxane (MAO) or pentafluoropheny 1 borate derivatives. Initial evaluation reactions of various titanium compounds with MAO have been published [1, 5–7]. SPS has attractive characteristics such as high melting temperature (about 270°C) and high crystallization rate. In particular, the thermal and mechanical behavior of SPS is very interesting if compared with that of an atactic and isotactic analogs [8]. Its high heat resistance and modulus of elasticity, low dielectric constant, excellent resistance to chemicals and relatively fast crystallization rate make SPS a potential thermoplastic for a large number of applications in the automotive and electronic industries [9].

A few studies on SPS-based blends such as SPS/poly(vinyl methyl ether) (PVME), SPS/poly(2,6-dimethyl-1,4-phenylene oxide) (PPO), SPS/poly(p-phenylene sulfide) (PPS), SPS/polyphenylene ether (PPE), and SPS/poly(styrene-co-a-methyl styrene) blend have been reported in the literature [10–14]. Hong et al. [15] investigated the miscibility of SPS/atactic polystyrene (APS) blends, whose constituent polymers have close T_gs by crystallization kinetics and enthalpy relaxation. It is observed from crystallization kinetics experiment that both the spherulite growth rate and the overall crystallization rate of SPS in blends decrease with an increasing amount of APS, indicating that SPS is diluted with APS. When enthalpy relaxations of the blends are examined, it is revealed that the enthalpy recovery of SPS/APS blends shows a single peak whose relaxation times is intermediate between those of SPS and APS. It is concluded that SPS/APS blends are completely miscible over the entire composition. Duff et al. [16] prepared the blends of SPS with polyphenylene ether (PPE) to determine the effect of blending on the crystallisation mechanism of SPS. The miscibility of the blend was confirmed by both differential scanning calorimetry (DSC) and dynamic mechanical thermal analysis (DMTA). Crystallisation of the blends was

[1] The article is published in the original.

studied under isothermal and non-isothermal conditions using DSC. X-ray diffraction (XRD) was used to determine that the SPS polymorph present was the β-form. The diffuse scattering was shown to increase with PPE content, particularly with blends prepared using higher molecular weight PPE. Overall, the results indicate that the crystallisation of SPS is affected by blending with PPE, with the melting enthalpy of SPS decreasing and the half-time to crystallisation increasing with PPE concentration. This is thought to occur because of the lack of flexibility in the PPE chain compared with the SPS chain.

Chiu et al. [14] examined the miscibility, crystallization kinetics, melting behavior and crystal structure of SPS/poly(styrene-*co*-α-methyl styrene) blends. DSC, polarized light microscopy and wide angle X-ray diffraction (WAXD) technique were used to approach the goals. The single composition-dependent T_gs of the blends and the melting temperature (T_m) depression of SPS in the blends indicated the miscible characteristic of the blend system at all compositions. Zhou et al. [17] studied isothermal crystallization, melting behavior and crystalline morphology of SPS blends with highly-impact polystyrene (HIPS). SPS blends with HIPS were prepared with a twin-screw extruder. Isothermal crystallization, melting behavior and crystalline morphology of SPS in SPS/HIPS blends were investigated by DSC, WAXD and polarized optical microscopy (POM). Experimental results indicated that the isothermal crystallization behavior of SPS in its blends not only depended on the melting temperature and crystallization temperature, but also on the HIPS content. Addition of HIPS restricted the crystallization of SPS melted at 320°C. For SPS melted at 280°C, addition of low HIPS content (10 wt % and 30 wt %) facilitated the crystallization of SPS and the formation of more content of α-crystal. However, addition of high HIPS content (50 wt % and 70 wt %) restricted the crystallization of SPS and facilitated the formation of β-crystal. More content of β-crystal was formed with increase of the melting and crystallization temperature.

Polymeric blends of melt processable polymers and liquid crystalline compounds have been studied in many researches. This review covers liquid crystalline (LC) blends containing low molar mass liquid crystal chemical (LCC). The main reason of blending low molar mass liquid crystal blends is to improving the melt viscosity of the blends. Buckley et al. [18] investigated the blends of LCC with either polyolefin or polyester. The LCC have molecular weight less than about 1000 g/mol. The LCC consists of groups *N*,*N*'-bis(*p*-methoxybenzylidene)-α,α'-bi-*p*-toluidine, *p*-methoxycinnamic acid, *N*,*N*'-bis(4-octyloxybenzylidene)-*p*-phenylenediamine. The LCC used is present in an amount of from about 0.5 to 5% by weight, and the melt viscosity of the blend was determined by a capillary rheometer. The melt viscosity of LCC blends reduced by as much as 25 to 30% compared with the pure matrix polymers. Siegmann et al. [19] prepared the polymer blends of liquid crystalline aromatic copolyester (based on 6-hydroxy-2-naphthanoic acid (HNA) and phydroxybenzoic acid) and an amorphous polyamide (PA) by melted mixing method. The rheological behavior of the blends was very different from pure component and viscosity of blends significantly changed. Only 5% by weight of liquid crystal polymer (LCP) in the blend could reduce the viscosity 20–25 times. Wacharawichanant et al. [20] investigated the effects on molecular motion in melt mixed poly(styreneco-acrylonitrile) (SAN) containing 25% by weight of acrylonitrile (AN) and poly(methyl methacrylate) (PMMA) (20/80 wt %) blends after adding two LCCs (CBC33 and CBC53) and two lubricants (GMS and zinc stearate) by using light scattering techniques. The samples were assessed in terms of the apparent diffusion coefficient (D_{app}) obtained from observation of phase separation in the blends. The early stages of phase separation as observed by light scattering were dominated by diffusion processes and approximately conformed to the Cahn–Hilliard linearised theory.

The major effect of LCC was to increase the molecular mobility of the blends. The LC generally increased the Cahn–Hilliard apparent diffusion coefficient, D_{app}, of the blend when added with concentrations as low as 0.2 wt %. GMS and zinc stearate can also improve the mobility of the blend but to a lesser extent and the effect does not increase at higher concentration. On the other hand, the more LCC added, the higher the mobility.

This work studied the crystallinity of SPS, which synthesized by homogeneous half-metallocene catalyst system, blend with various polymers. Also, the effect of LCC and GMS on the crystallinity of the polymer blends was the first time to investigate by wide-angle X-ray diffraction (WAXD). It will also be interesting to investigate the crystalline properties of

SPS in the blends to compare with previous reports and understand the background phenomena beside. The effects of addition of LCC or GMS in homopolymer [21–23] and in phase separated blends [20] are reported, but the effects in crystallinity is new and highly interesting.

2. EXPERIMENTAL

2.1. Materials

SPS was synthesized in our laboratory. The percent syndiotactic index is 93.38%, the weight average molecular weight (M_w) is 1943500 g/mol and the number average molecular weight (M_n) is 592300 g/mol. The melting temperature (T_m) and the glass transition temperature (T_g) are 271.41°C and 97.90°C, respectively. Poly(*n*-butyl methacrylate) (PBMA), poly(α-methyl styrene) (PaMS), poly(cyclohexyl acrylate)

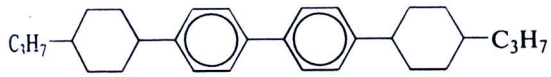


Fig. 1. Structure of CBC33.

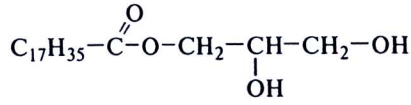


Fig. 2. Structure of glycerol monostearate (GMS).

(PCHA), were purchased from Scientific Polymer Products, Inc. and used as received.

Low molar mass liquid crystal chemical (LCC, cyclohexyl-biphenyl-cyclohexane (CBC33)) was purchased from Merck Co., Ltd. CBC33 liquid crystal was used in this research in the form of a white powder. Its structure which contains a cyclohexyl-biphenyl-cyclohexane backbone is shown as Fig. 1. Molecular weight characteristics, transition temperatures, and other physical properties of CBC33 are shown in Table 1. The lubricant, glycerol monostearate (GMS) was kindly provided by Rikevita Ltd. (Malasia). The melting point is 65°C and the molecular weight is 358 g/mol. The chemical structure of GMS is shown in Fig. 2.

2.2. Polymer Blend Preparation

The blends of SPS and other polymer with or without LCC or lubricant were prepared by using a digital hot plate at various compositions. The blends of SPS and another polymer in the group of PaMS, PBMA, and PCHA respectively were melt-mixed on hot plate each at the SPS composition of 80, 60, and 40%. The blends were further melt-mixed with CBC33 or GMS of 1 wt % each at 310°C. After homogenized, all the samples were kept at 300°C for five minutes and immediately quenched to 200°C and held for twenty minutes and cool down before further experiments at room temperature.

2.3. Polymer Characterization

The molecular weight (M_w) and molecular weight distribution (MWD) were investigated by gel permeation chromatography (GPC). Samples were prepared accurately at concentration of approximately 0.5–1.0 mg/ml in the mobile phase and dissolved by using the PL-SP 260 GPC sample preparation system at a temperature of 150°C for approximately hour. The dissolved sampled were transferred into PL-GPC 220. GPC were performed at Thai Petrochemical Industry Public Co., Ltd. The glass transition temperature (T_g) values of the polymers were determined with a Perkin-Elmer DSC-Diamond. The analyses were performed at the heating rate of 20°C/min in the temperature range 50 to 300°C. X-ray diffraction (XRD) was performed to determine the bulk crystalline phase of samples. It was conducted using a SIEMENS D-5000 X-ray diffractometer with CuK_α radiation (λ = 1.54439 Å). The spectra were scanned at a rate of 0.04 degree/second in the range 2θ = 10–40 degree.

3. RESULTS AND DISCUSSION

3.1. Crystallization Controlled Conditions

All the blends produced in this research have the same crystallization condition. As freshly melted at 300°C which is higher than the crystalline melting point of pure SPS at 272°C, the blends were left at 200°C long enough to fully established crystallinity. Thus, all the blends have the same thermal history of the isothermal crystallization at 200°C. The PaMS, PBMA and PCHA each can be miscible with SPS in all the composition ranges utilized in this research. Usually the crystallization of the semi-crystalline polymer largely depended on the thermal history of the system. The SPS can have four kinds of crystal, namely α, β, γ and δ. The α and β crystal can be thermally formed from the melt SPS, while δ and γ crystal can be formed from the solution of special solvent [24–25].

3.2. Glass Transition Temperature

The T_g is a characteristic of the amorphous part of polymers. At T_g, a dramatic change occurs in the local movement of molecule level of polymer chain from glassy state to rubbery state, which changes almost all of the physical and mechanical properties of polymer [26].

The miscibility of binary blends is frequently ascertained by measurements of their T_g. Figure 3 shows T_g of each composition of SPS/PaMS blend. It is observed that the T_g of pure SPS, PaMS, PBMA and PCHA is 97.90, 87.33, 31.85 and 25.49°C, respectively. All the blends with different compositions exhibit single T_g which shifted to a higher temperatures in the same trend as the SPS content in the samples. This result may imply the miscibility of the two components in the blends under the DSC condition. The thermal characteristics of SPS/PaMS/CBC33 blends and SPS/PaMS/GMS blends show that T_g of binary blends are close to those of their blends with CBC33 and GMS. The difference between T_g of

Table 1. Properties of low molar mass thermotropic liquid crystals CBC33

Melting point, °C	Smectic-Nematic Temperature, °C	Clearing Temperature, °C	Molecular weight, g/mol
158	223	327	403

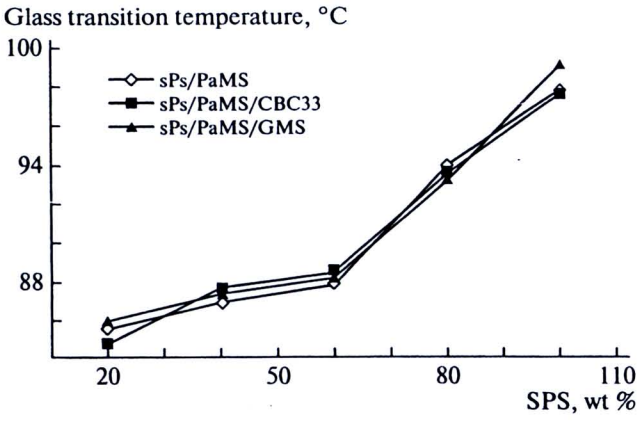


Fig. 3. Glass transition temperature of SPS/PaMS blends before and after adding CBC33 and GMS.

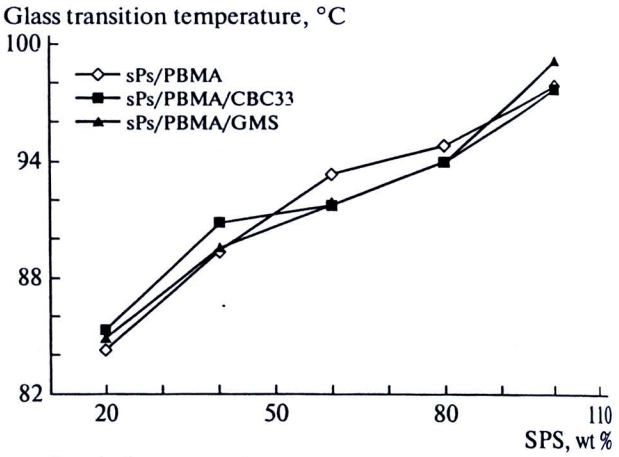


Fig. 4. Glass transition temperature SPS/PBMA blends before and after adding CBC33 and GMS.

binary blends and their blends with additives are less than 1°C, and cannot be distinguished from each other. These phenomena may be resulted from the too small (1.0% w/w) amount of additives in the matrix phase of the binary blends that are not enough to plasticize the blends to such an extent that the significant reducing in T_g of the blends can be observed.

Figures 4, 5 show T_g of each composition of SPS/PBMA and SPS/PCHA blend. It is observed that all the blends with different compositions exhibit single T_g which shifts to a higher temperature with the SPS content. This result may imply the miscibility of the two components in the amorphous state of the blends. The values of T_g of binary blends are close to those of their blends with CBC33 and GMS. Thus, the additions of CBC33 and GMS have not significantly affected T_g of SPS/PBMA and SPS/PCHA blends as same as SPS/PaMS blends.

From these results, it was found that the SPS have tendency to be miscible with PaMS, PBMA and PCHA by melt mixing method. The glass transition temperatures of all the blends with additives do not significantly change from T_g of additive-free binary blends. This phenomenon proves that additives do not have direct plasticizing effects on glass transition temperature of pure binary blends.

3.3. Effect of Additives on the Crystallinity

The crystallinity is determined by measuring the integrated area of the crystalline reflections and the integrated area of the non-crystalline background and comparing the two. In this research calculated percent of crystallinity from Ruland's Method [27].

The intensity of the X-rays scattered over all angles by a given assemblage of atoms is independent of their state of order or disorder. It follows that if the crystalline and amorphous scattering in the diffraction pattern can be separated from each other, the crystalline fraction is equal to the ratio of the integrated crystalline scattering to the total scattering, both crystalline and amorphous. In the ensuing treatment, we shall adhere rather closely to the presentation given by Ruland [27]. We designate the magnitude of reciprocal-lattice vector ρ_{hkl} by the symbol s.

$$s = \frac{2\sin\theta}{\lambda} \tag{1}$$

The fraction of crystalline material in the specimen is given by

$$x_c = \frac{\int_{s_0}^{s_p} s^2 I_c ds}{\int_{s_0}^{s_p} s^2 I ds}(K(s_0, s_p, D, \bar{f}^2)) = \text{const.} \tag{2}$$

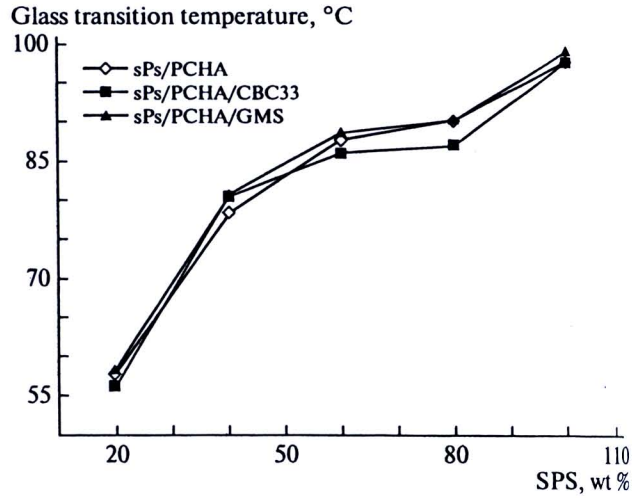


Fig. 5. Glass transition temperature SPS/PCHA blends before and after adding CBC33 and GMS.

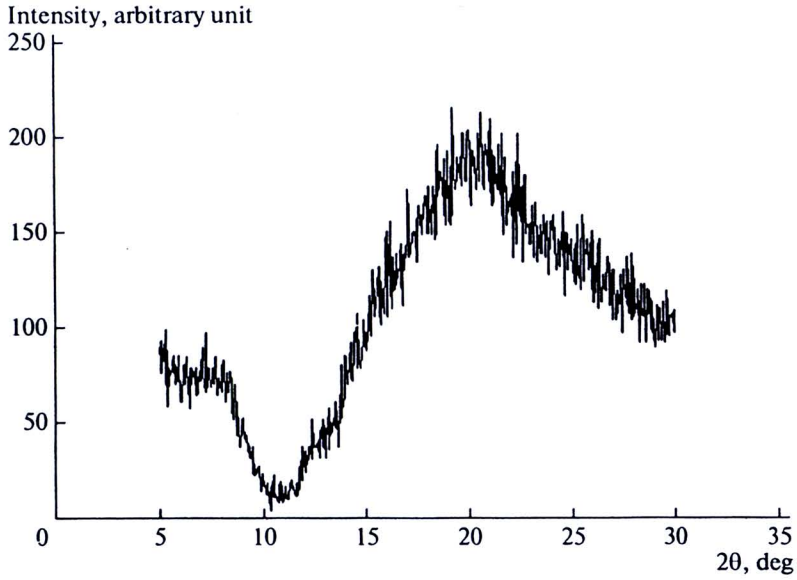


Fig. 6. X-ray diffraction pattern of pure amorphous SPS.

$I(s)$ is the intensity of coherent X-ray scattering from a specimen at the point s in reciprocal space. $I_c(s)$ is the part of the intensity at the same point that is concentrated in the crystalline peaks. ($K(s_0, s_p, D, \bar{f}^2)$) is lost from peaks and appears as diffuse scatter in the background as a result of atomic thermal vibrations and lattice imperfections. The K can be found from the empirical chart and can be assume as a constant for each system.

However, Ruland found that calculated values of the coefficient K is

$$K = \frac{\int_{s_0}^{s_p} s^2 \bar{f}^2 ds}{\int_{s_0}^{s_p} s^2 \bar{f}^2 D ds} \quad (3)$$

X-ray diffraction pattern of pure amorphous SPS came from the melted SPS scattering at 300°C and is shown in Fig. 6. The curve is look like back of the turtle without any peak at all. All the crystalline content come from the excess area above the summation of the pure amorphous SPS and the amorphous another polymer weighs by composition of the polymer in the blend.

The percent crystallinity in Tables 2–4 come from the XRD data of the blend as shown in Figs. 7–9 and the pure component and were calculated according to the method that explains above. Crystallinity measurements offer a useful way to ascertain the influence of another polymer blended with SPS on the crystallization behaviour of SPS. Table 2 shows percent crystallinity of SPS/PaMS, SPS/PaMS/GMS and SPS/PaMS/LCC blends at various compositions. As the PaMS content increases, percent crystallinity decrease.

When LCC and GMS were added into the pure SPS, percent crystallinity decreased about 6–7%. This might be because of the faster movement of molecules SPS that results from the contribution from small molecules [20–22]. However, the GMS affect the crystallinity of SPS in the same quantity as LCC regardless of the different function of the additive. The LCC can increase the mobility of the bulk phases [21] while the GMS cannot [20]. Nevertheless, the variation of the crystallinity of the pure SPS when added the additive of GMS and LCC is in the error limit of the experiments. Thus, we cannot definitely conclude about these depressions of the amount of crystal of SPS. In other word, the depressions can be negligible. The same 100% SPS data will be used in Tables 2–5.

Table 2 and Fig. 7 showed the depression of the quantity of the SPS crystal from pure 100% SPS. However, the depression according to the blend and

Table 2. Crystallinity of SPS/PaMS, SPS/PaMS/GMS and SPS/PaMS/LCC blends at various compositions

% SPS	% Crystallinity		
	SPS/PaMS	SPS/PaMS/GMS	SPS/PaMS/LCC
40	19	39	20
60	24	27	23
80	38	27	29
100	57	49	52

Table 3. Crystallinity of SPS/PBMA, SPS/PBMA/GMS and SPS/PBMA/LCC blends at various compositions

% SPS	% Crystallinity		
	SPS/PBMA	SPS/PBMA/GMS	SPS/PBMA/LCC
40	40	37	35
60	37	34	31
80	38	38	42
100	57	50	52

Table 4. Crystallinity of SPS/PCHA, SPS/PCHA/GMS and SPS/PCHA/LCC blends at various compositions

% SPS	% Crystallinity		
	SPS/PCHA	SPS/PCHA/GMS	SPS/PCHA/LCC
40	35	37	29
60	47	37	28
80	44	40	29
100	57	50	52

Table 5. Reduction in Crystallinity at 40% SPS compared with 100% SPS

Second polymer	Crystallinity (Reduction, %)		
	Blend	Blend/GMS	Blend/LCC
PaMS	19 (−66.2)	39 (−22.3)	20 (−61.3)
PBMA	40 (−30.9)	37 (−25.5)	35 (−32.6)
PCHA	35 (−39:2)	37 (−25.4)	29 (−44.0)

the blend/LCC is approximately the same while the depression according to the blend/GMS comes with less extent. Normally, the miscible blends of crystalline polymer and the amorphous polymer will reduce the crystalline melting temperature and the percent crystal in the blends according to the dilution effects. Thus, the LCC did not depress the percent crystal of SPS in the blends of PaMS more than the normal miscible blend of PaMS, while the GMS helped maintain high level of percent crystal of SPS.

Figure 8 shows the X-ray diffraction patterns for SPS/PBMA blends and their blend with additives at various compositions. Table 3 shows percent crystallinity of SPS/PBMA, SPS/PBMA/GMS and SPS/PBMA/LCC blends at various compositions. As the PBMA content increases, percent of the crystallinity decreases. For the effects of addition LCC and GMS, no effect in reduction of percent crystallinity of SPS/PBMA blends has occurred as well as SPS/PaMS blends.

The depression of the percent crytallinity of SPS when cooperated with PBMA is less than with PaMS. However, the depression according to LCC close to that for the pure blend and quite equal amount of depression according to GMS were found also with the blend of PBMA.

Figure 9 shows the X-ray diffraction patterns for SPS/PCHA blends and their blend with additives at various compositions. Table 4 shows percent crystallinity of SPS/PCHA, SPS/PCHA/GMS and SPS/PCHA/LCC blends at various compositions. As the PCHA content increases, percent of crystallinity decreases. The amount of the depression of the crystallinity from PCHA is slightly larger than that from PBMA. This might be because PBMA has the methyl group at the acrylate so its miscibility is less than that for PCHA which has no group at the acrylate. According to the steric hindrance of the methyl group, the PBMA is less miscible with SPS compared to PCHA regardless of the side group of the acrylate. However, the PaMS has the most depression effects and even better than the PCHA. The reason is that PaMS has the most similar molecules with the SPS and thus form the most miscible pair with SPS. In this research, the most compatible pair with SPS can be arrange as PaMS > PCHA > PBMA, and the depression of the crystallinity of SPS will be in the same order.

From Tables 2–4, it is seen that the percent crystallinities decrease when the percent of SPS in the blend dacreases. However, in the first step of reduction of SPS content (to 80 wt %), the percent of the crystallinity dramatically decreases compared to other steps. This result correspond to the previous DSC study [23] that detect the dramatically decrease in T_g in 80 wt % SPS samples. For lower concentrations of SPS, both XRD and DSC results show some depression when adding the second polymer to the SPS but in the smaller amount than for 80 wt % samples.

Table 5 concluded the effects of depression of crystallinity of SPS when blend with another polymer with or without GMS or LCC. We have selected the maximum dilution of 40% SPS to effectively monitor the effects of the 1 wt % additive (GMS and LCC). As we have discuss, the most reduction in percent crystallinity of SPS can be labeled as PaMS > PCHA > PBMA. The depression according to LCC cannot be distinguished from that of normal pure blend. Moreover, when concentrated on the effects from GMS, the depressions caused by GMS are in the same range (≈−25%) regardless of the system proposed (PaMS, PCHA, or PBMA). Nevertheless the PaMS systems showed the lowest depression according to GMS. This might be because of the functionality of GMS that different from LCC. The GMS does not increase the mobility of the bulk phase as the LCC does [20], so the effects from the addition are not the same. The GMS

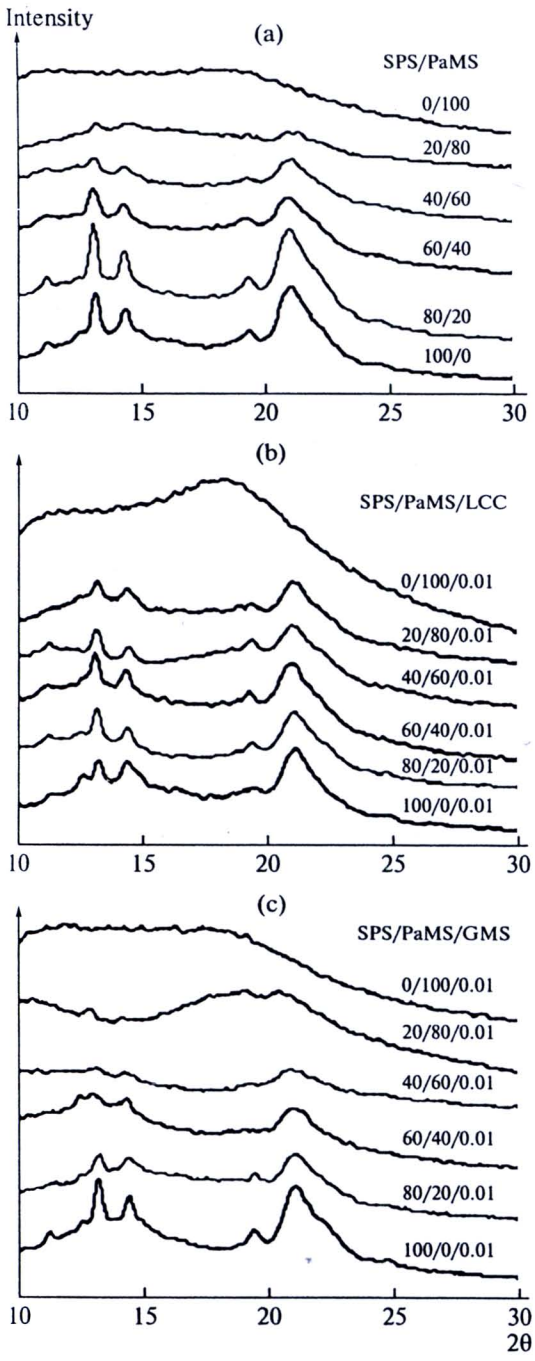


Fig. 7. The X-ray diffraction patterns for SPS/PaMS blends and their blend with additives at various compositions: (a) SPS/PaMS blends; (b) SPS/PaMS/LCC blends with 1 wt% of LLC and (c) SPS/PaMS/GMS blends with 1 wt % of GMS. % SPS = 0, 20, 40, 60, 80 and 100.

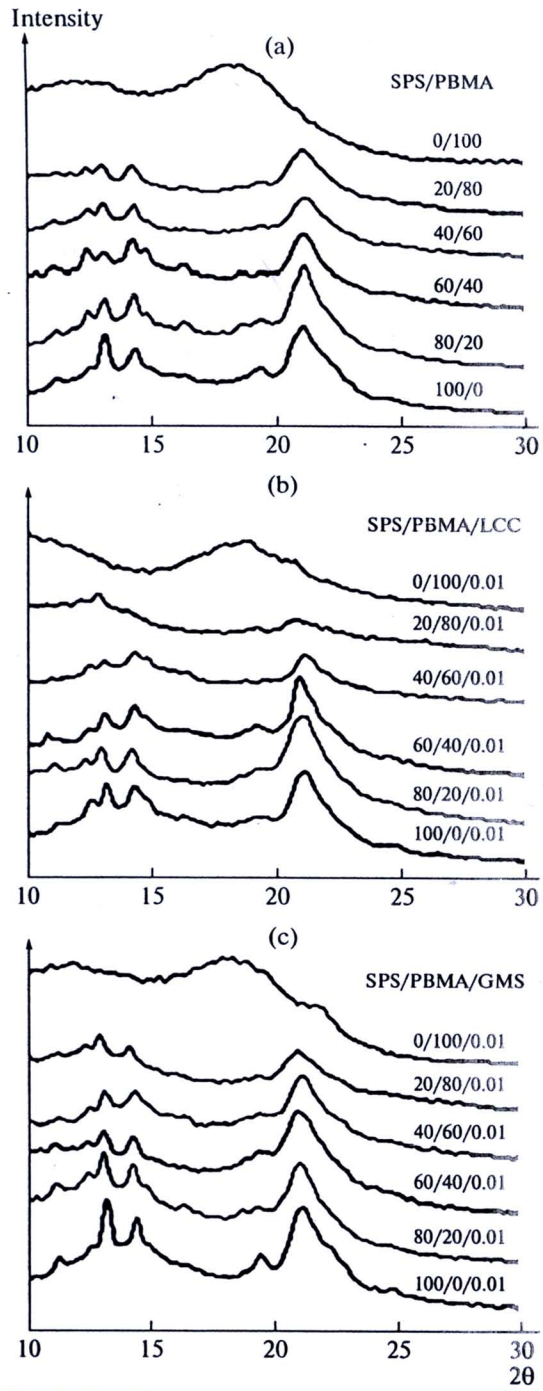


Fig. 8. The X-ray diffraction patterns for SPS/PBMA blends and their blend with additives at various compositions: (a) SPS/PBMA blends; (b) SPS/PBMA/LCC blends with 1 wt % of LLC and (c) SPS/PBMA/GMS blends with 1 wt % of GMS. % SPS = 0, 20, 40, 60, 80 and 100.

might hinder the movement of the molecules of the bulk polymer, so the SPS tended to be crystal rather dissolve in the amourphous phase. The mobility effect of LCC cannot clearly be seen from comparison with the data for the pure blend. This might be because of the small amount of LCC is harder to monitor. However, no large variation in the series of LCC has been found. Thus, the LCC has no effects on crystallinity.

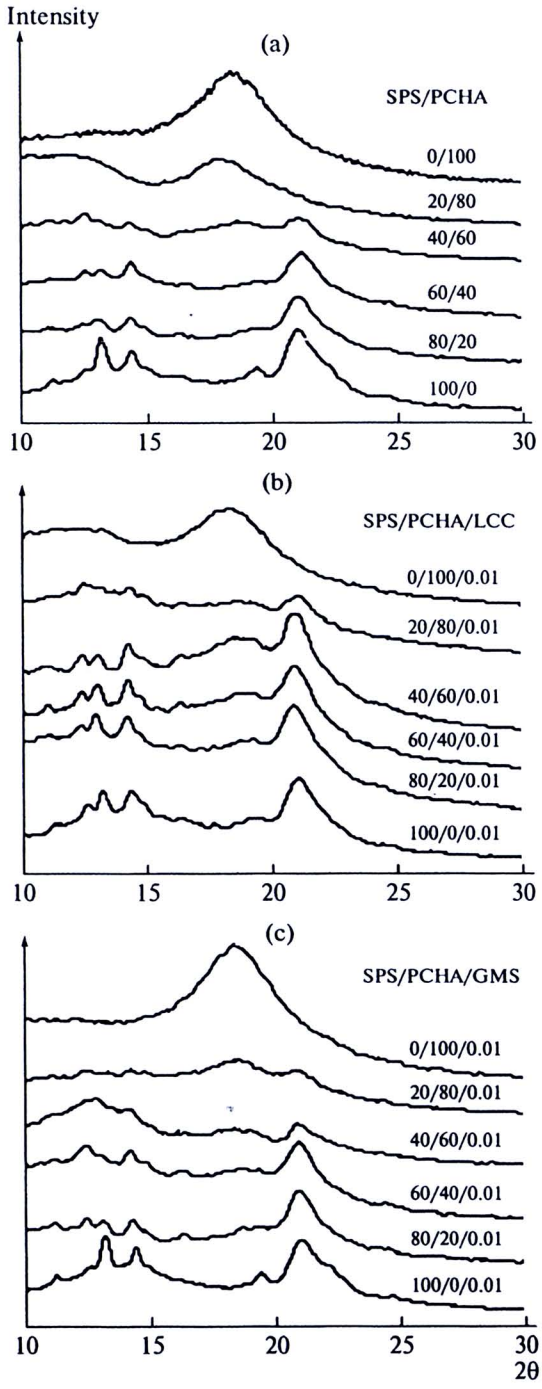


Fig. 9. The X-ray diffraction patterns for SPS/PCHA blends and their blend with additives at various compositions: (a) SPS/PCHA blends; (b) SPS/PCHA/LCC blends with 1 wt% of LLC and (c) SPS/PCHA/GMS blends with 1 wt% of GMS. % SPS = 0, 20, 40, 60, 80 and 100.

4. CONCLUSIONS

In this research, it was found that the SPS have tendency to be miscible with PaMS, PBMA and PCHA by melt mixing method. The glass transition temperatures of all the blends with additives do not significantly change from additive-free binary blends. The percent of crystallinity of SPS blended with several polymers such as PaMS, PBMA, and PCHA were investigated at various concentrations with or without 1% wt additive that are GMS or LCC. From XRD results, the percent crystallinity of the blend is measured and found to decrease when decrease the percent of SPS in the blend. This may be resulted from the larger amorphous phase or dilution of SPS in the pure blend of low concentration of SPS. The depression of the percent crystallinity is in the order of PaMS > PCHA > PBMA according to the compatibility with the SPS. The depressions are usually largest at the reduction of SPS content to 80 wt % SPS and slightly decrease as the more dilution of SPS. The addition of GMS in the 40% SPS blend reduced around 25% of the SPS crystallinity from 57% in the pure SPS regardless of the components of the blend. The addition of LCC in the 40% SPS blend has no effect on SPS crystallinity that remains close to that of the pure blend without LCC. These might be because of the low concentration of LCC and the compatibility of LCC with the blend. The different effects of GMS and LCC might be because of the different function of the molecules in the blend. The LCC will increase the mobility of the polymer molecules [18, 20–21] while the GMS might impede the movement of the SPS molecules that will results in the higher equilibrium quantities of the SPS crystal in all systems.

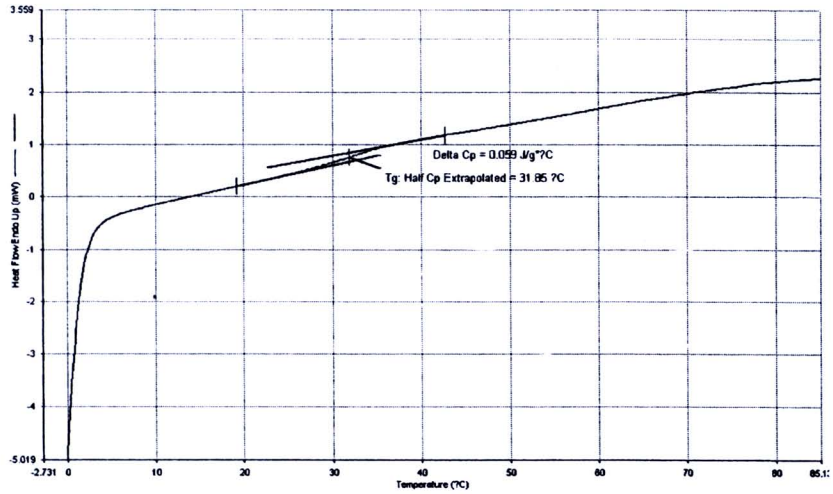
REFERENCES

1. N. Ishihara, T. Seimiya, M. Kuramoto, and M. Uoi, Macromolecules **19**, 2464 (1986).
2. A. Zambelli, P. Longo, C. Pellecchia, and A. Grassi, Macromolecules **20**, 2035 (1987).
3. A. Zambelli, L. Oliva, and C. Pellecchia, Macromolecules **22**, 2129 (1989).
4. R. Fan, K. Cao, B. Li, et al., Eur. Polym. J. **37**, 2335 (2001).
5. N. Ishihara, M. Kuramoto, and M. Uoi, Macromolecules **21**, 3356 (1988).
6. M. Kobayashi, T. Nakaoki, and N. Ishihara, Macromolecules **22**, 4377 (1989).
7. A. Zambelli, L. Oliva, and C. Pellecchia, Macromolecules **22**, 2129 (1989).
8. F. Picchioni, M. Aglietto, E. Passaglia, and F. Ciardelli, Polymer **43**, 3323 (2002).
9. B. Chen, X. Li, S. Xu, et al., Polymer **43**, 953 (2002).
10. T. K. Mandal and E. M. Woo, Polymer **40**, 2813 (1999).
11. B. K. Hong, W. H. Jo, S. C. Lee, and J. Kim, Polymer **39**, 1793 (1998).
12. S. H. Hwang, M. J. Kim, and J. C. Jung, Eur. Polym. J. **38**, 1881 (2002).
13. S. Stack, O. Donoghue, and C. Birkinshaw, Polym. Degrad. Stab. **79**, 29 (2003).
14. F. C. Chiu and M. T. Li, Polymer **44**, 8013 (2003).

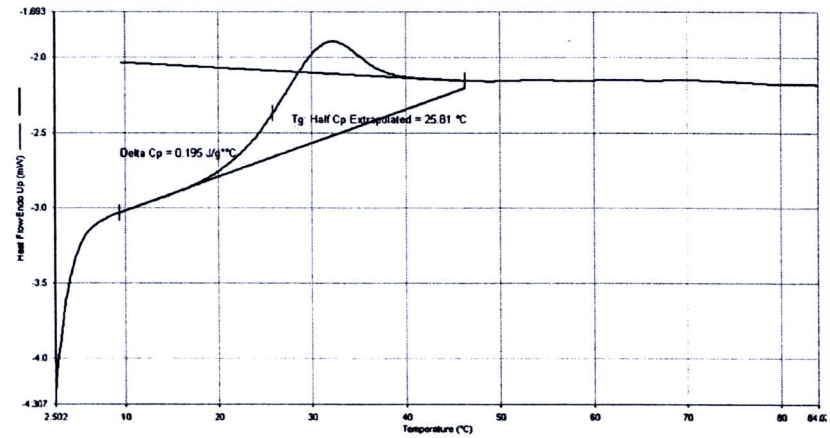
15. B. K. Hong, W. H. Jo, and J. Kim, Polymer **39**, 3753 (1998).
16. S. Duff, S. Tsuyama, T. Iwamoto, et al., Polymer **42**, 991 (2001).
17. W. Zhou, M. Lu, and K. Mai, Polymer **48**, 3858 (2007).
18. A. Buckley, A. B. Conciatori, and G. W. Calundann, US Patent No. 4434262 (1984).
19. A. Siegmann, A. Dagan, and S. Kenig, Polymer **26**, 1325 (1985).
20. S. Wacharawichanant, S. Thongyai, S. Tanodekaew, et al., Polymer **45**, 2201 (2004).
21. N. Motong, N. Clarke, R. L. Thompson, et al., J. Polym. Sci. Part B: Polym. Phys. **45**, 2187 (2007).
22. N. Motong, S. Thongyai, and N. Clarke, J. Appl. Polym. Sci. **107**, 1108 (2008).
23. S. Khunprasert, S. Thongyai, W. Chinsirikul, and S. Wacharawichanant, J. Appl. Polym. Sci. (in press).
24. T.-M. Wu, S.-F. Hsu, and J.-Y. Wu, J. Polym. Sci., Part A: Polym. Chem. **41**, 560 (2003).
25. T.-M. Wu, S.-F. Hsu, and J.-Y. Wu, Polym. Eng. Sci. **42**, 2295 (2002).
26. J. Brandrup and E. H. Immergut, *Polymer Handbook* (Wiley, New York, 1989).
27. L. E. Alexander, *X-Ray Diffraction Methods in Polymer Science* (Wiley, New York, 1969).

ข้อมูลการทดลองโดยละเอียดตอนที่หนึ่ง

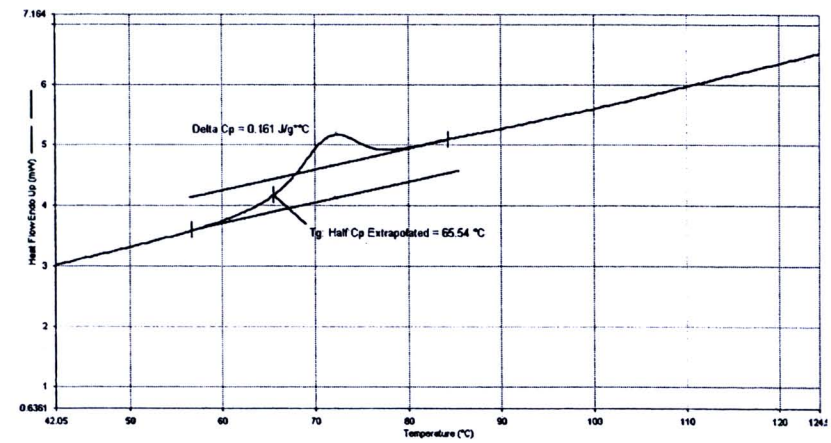
The Data of DSC Characterization



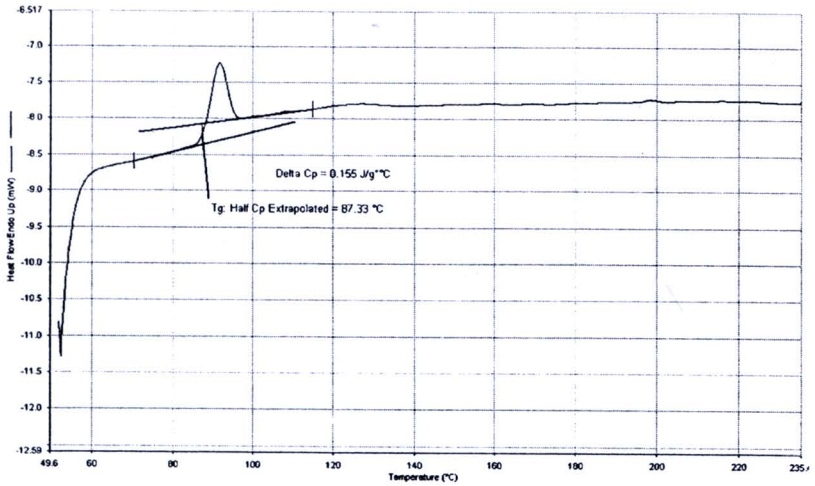
รูปที่ A.1 DSC curve of PBMA



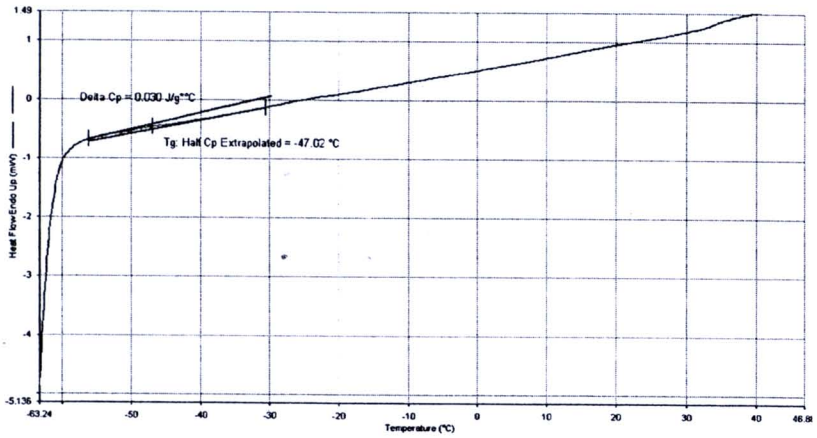
รูปที่ A.2 DSC curve of PCHA



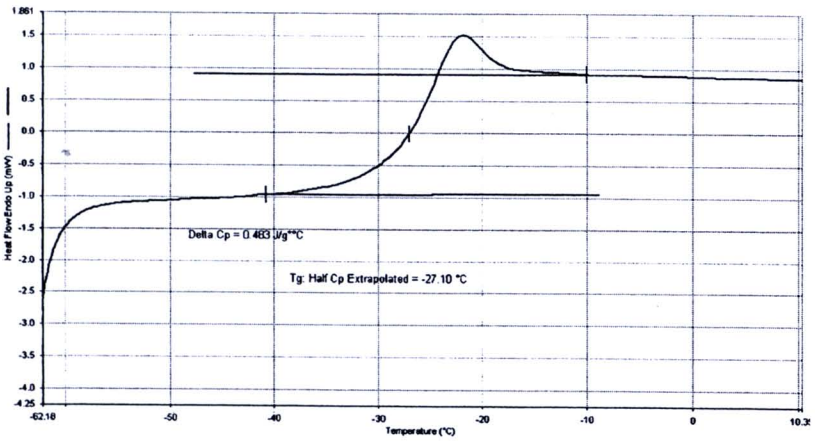
รูปที่ A.3 DSC curve of PEMA



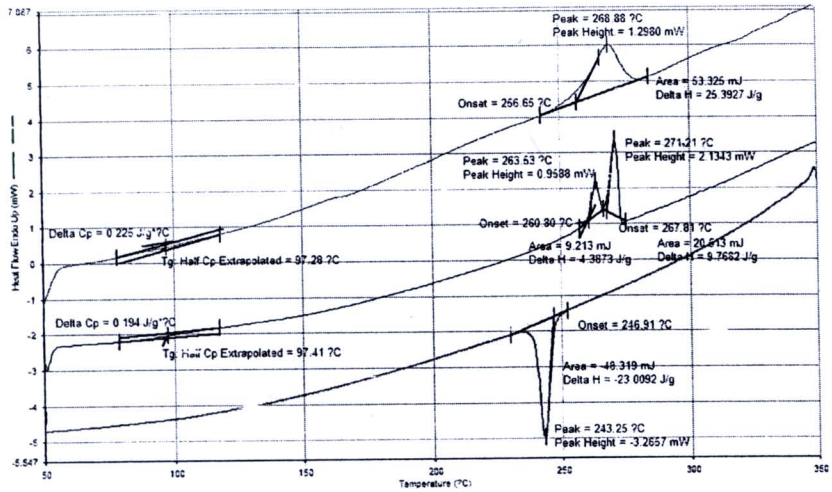
รูปที่ A.4 DSC curve of Poly(α-methylstyrene)



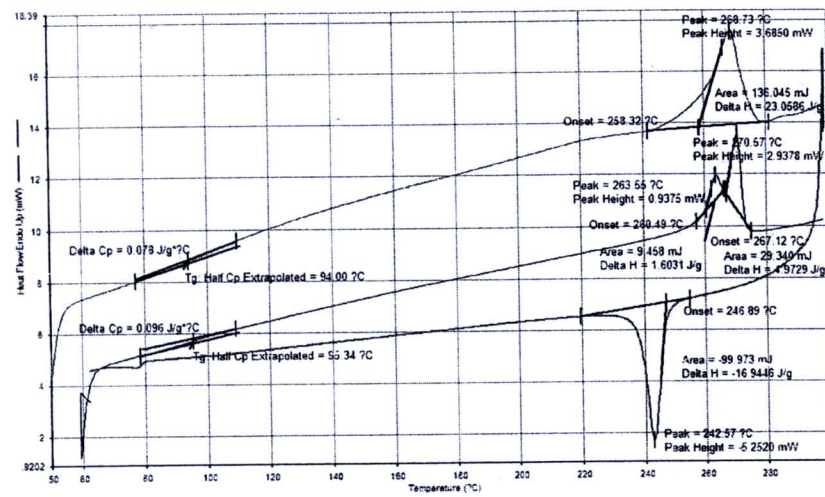
รูปที่ A.5 DSC curve of Polyisoprene



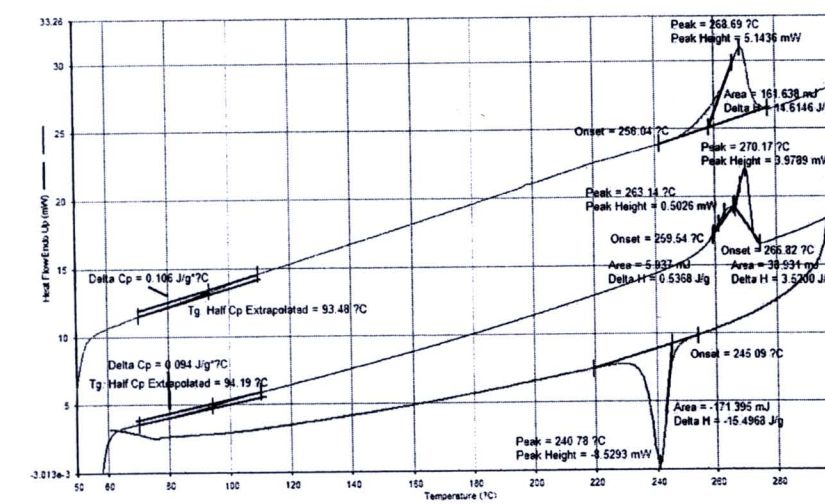
รูปที่ A.6 DSC curve of PVME



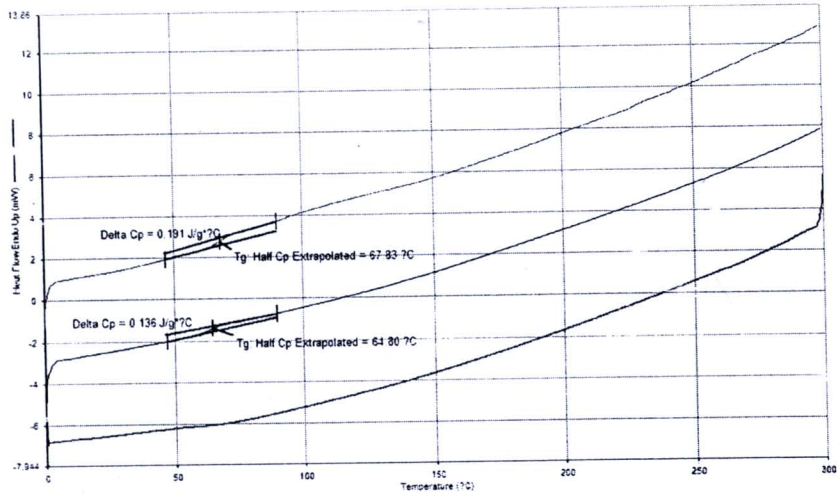
รูปที่ A.7 DSC curve of sPS1



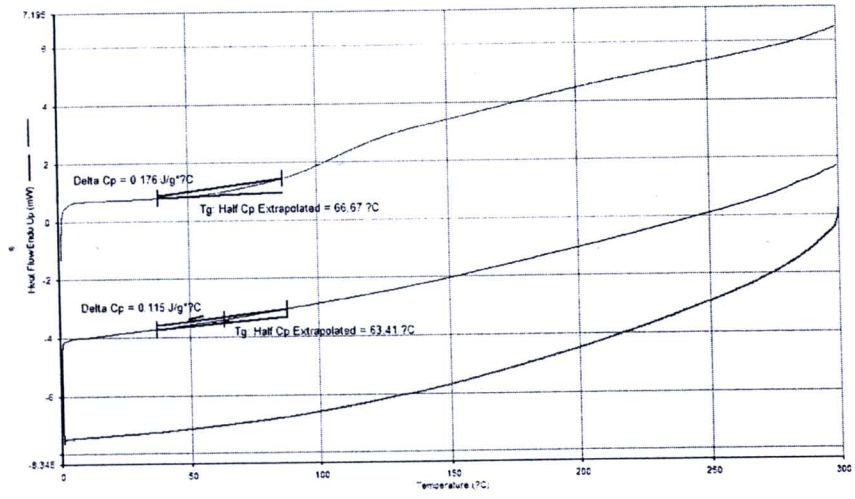
รูปที่ A.8 DSC curve of sPS2



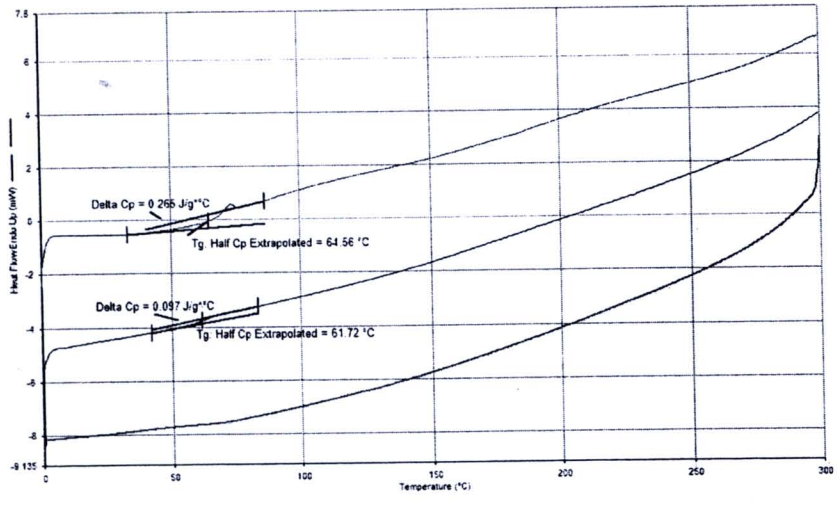
รูปที่ A.9 DSC curve of sPS3



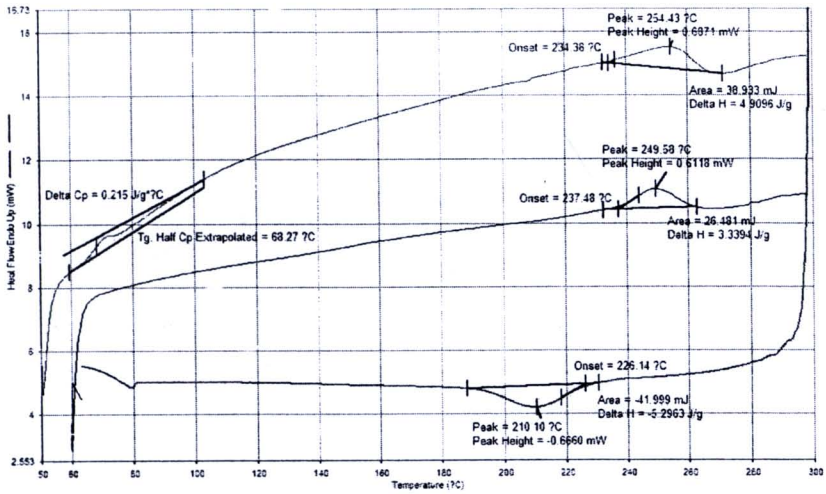
รูปที่ A.10 DSC curve of sPS1 / PBMA blends at composition 50/50 wt%



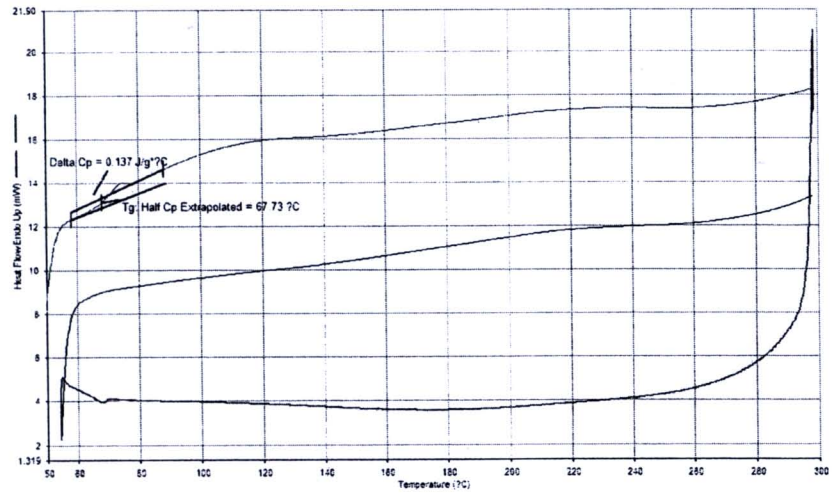
รูปที่ A.11 DSC curve of sPS2 / PBMA blends at composition 50/50 wt%



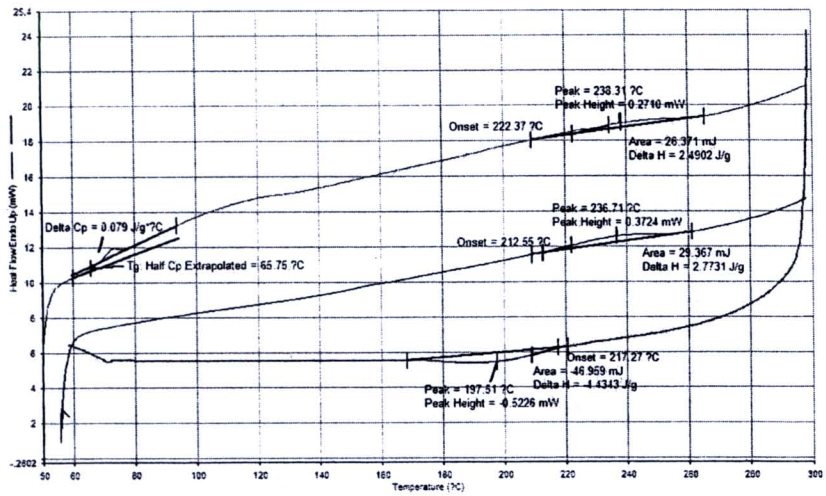
รูปที่ A.12 DSC curve of sPS3 / PBMA blends at composition 50/50 wt%



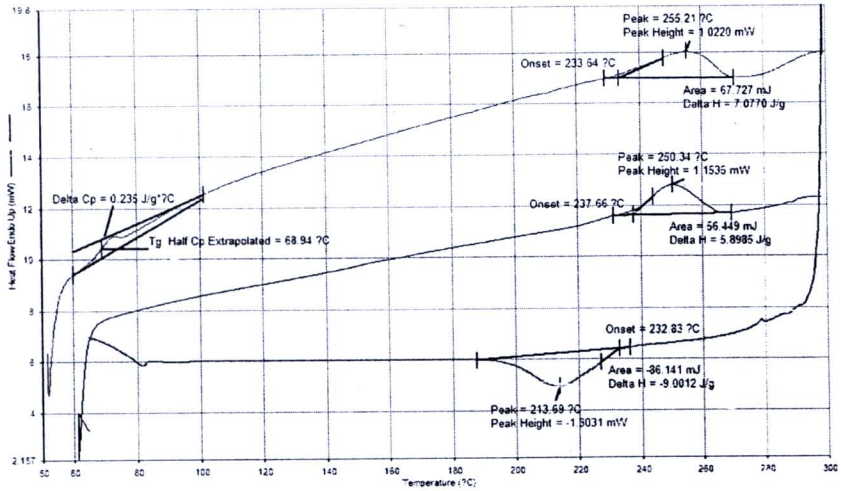
รูปที่ A.13 DSC curve of sPS1 / PBMA blends at composition 60/40 wt%



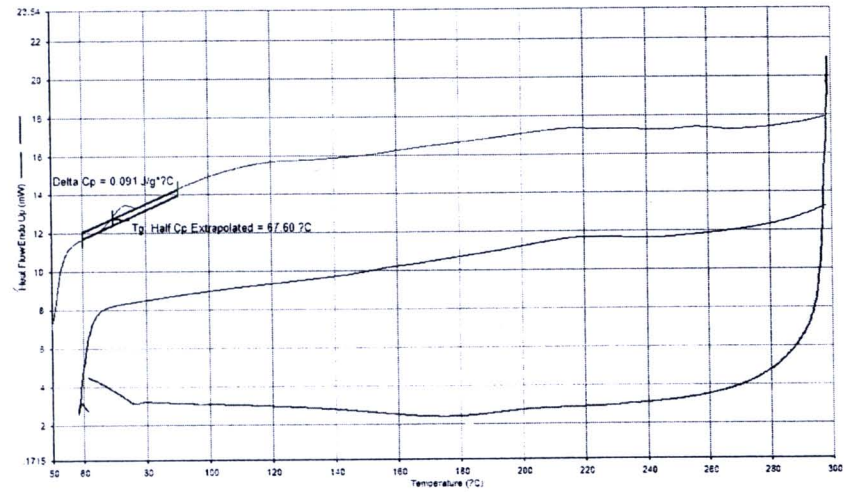
รูปที่ A.14 DSC curve of sPS2 / PBMA blends at composition 60/40 wt%



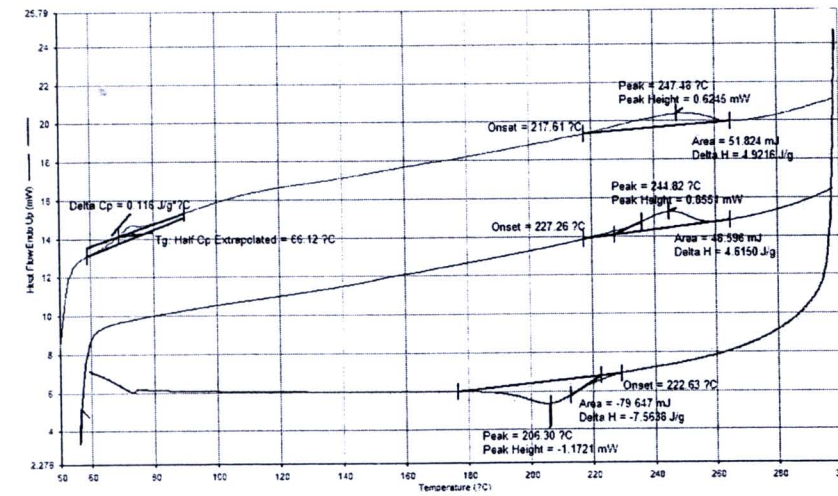
รูปที่ A.15 DSC curve of sPS3 / PBMA blends at composition 60/40 wt%



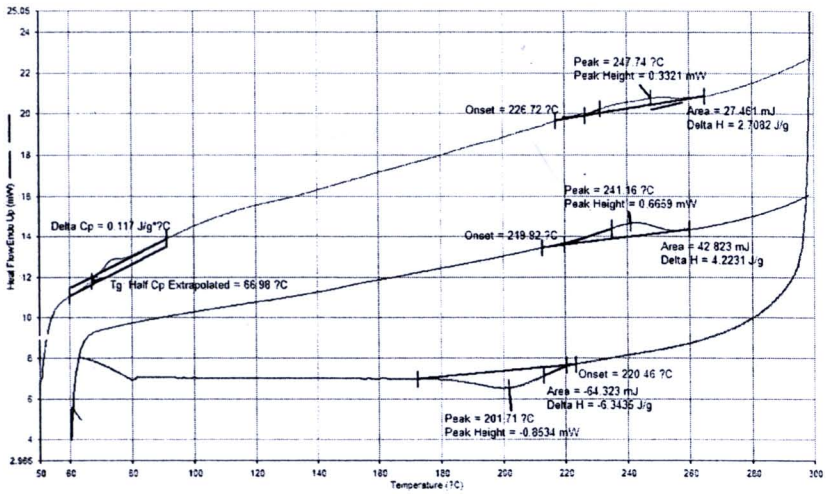
รูปที่ A.16 DSC curve of sPS1 / PBMA blends at composition 70/30 wt%



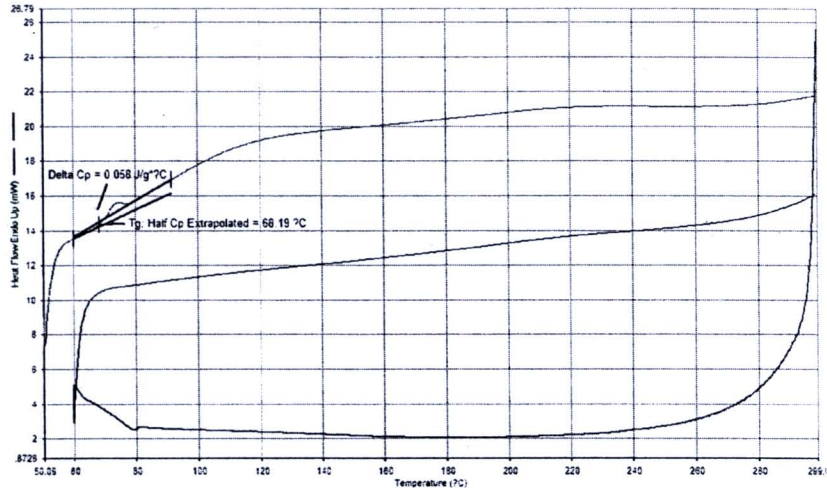
รูปที่ A.17 DSC curve of sPS2 / PBMA blends at composition 70/30 wt%



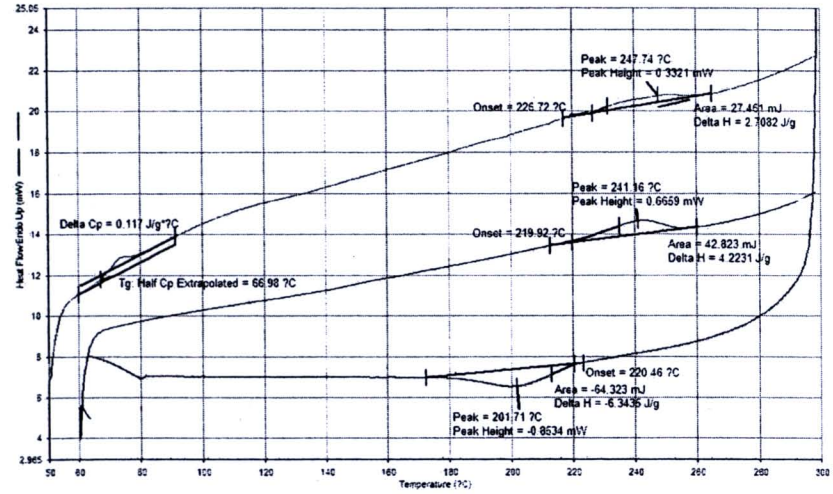
รูปที่ A.18 DSC curve of sPS3 / PBMA blends at composition 70/30 wt%



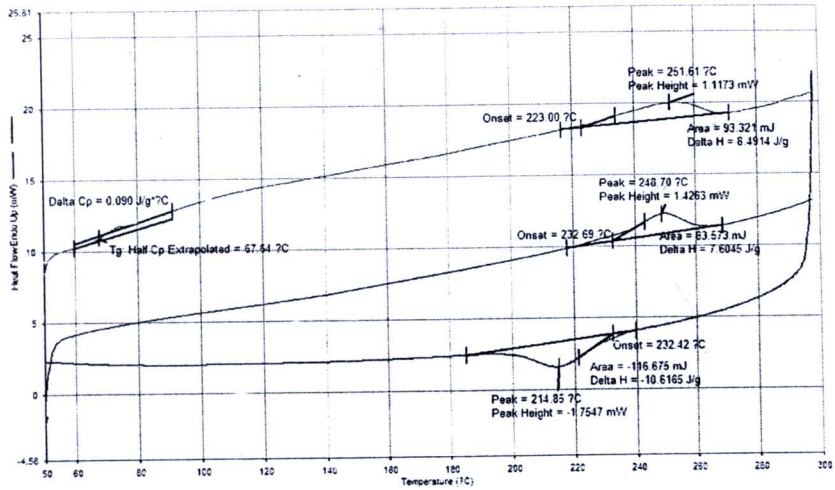
รูปที่ A.19 DSC curve of sPS1 / PBMA blends at composition 80/20 wt%



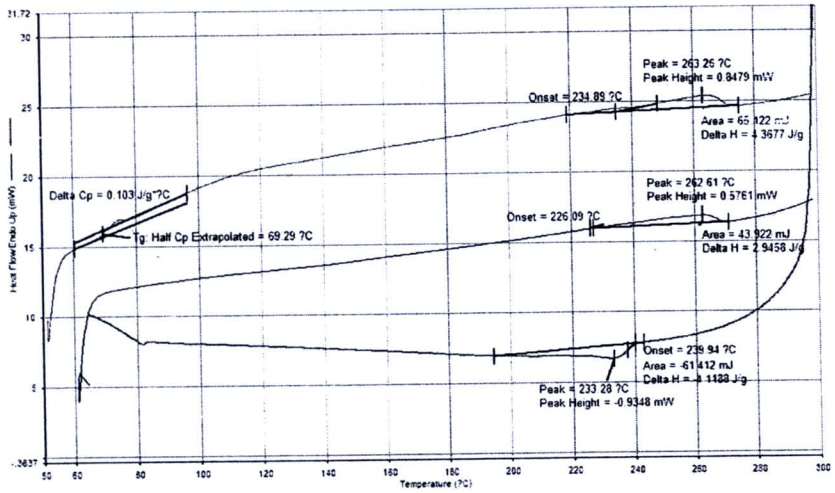
รูปที่ A.20 DSC curve of sPS2 / PBMA blends at composition 80/20 wt%



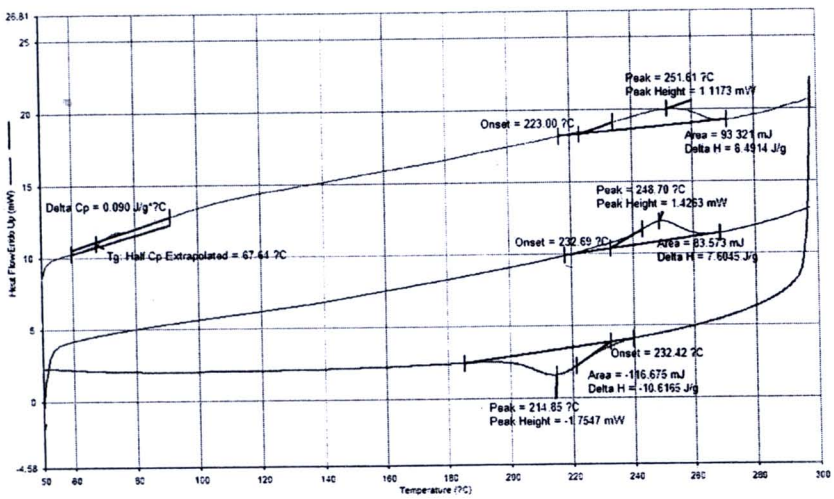
รูปที่ A.21 DSC curve of sPS3 / PBMA blends at composition 80/20 wt%



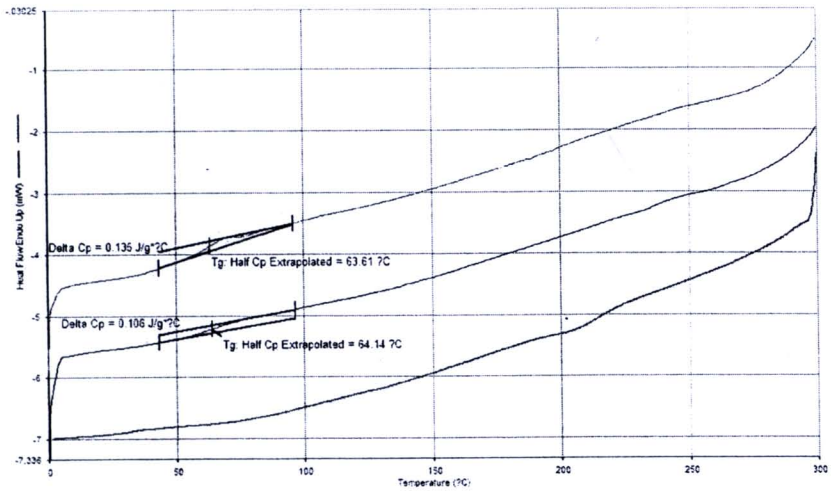
รูปที่ A.22 DSC curve of sPS1 / PBMA blends at composition 90/10 wt%



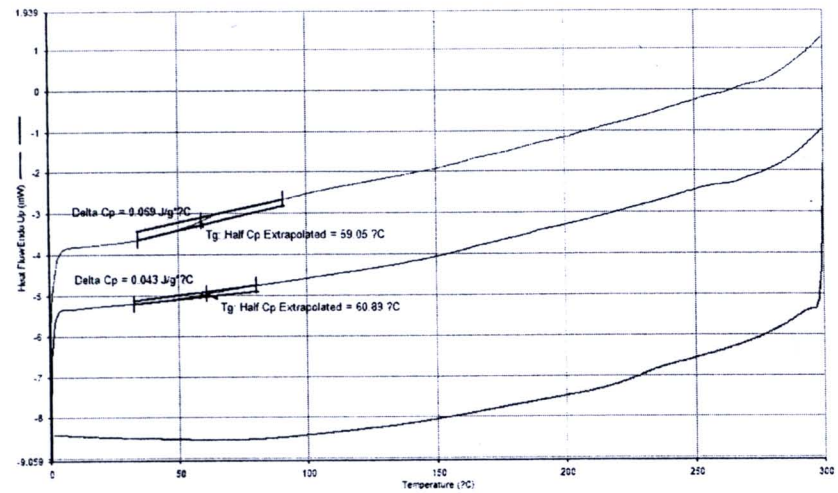
รูปที่ A.23 DSC curve of sPS2 / PBMA blends at composition 90/10 wt%



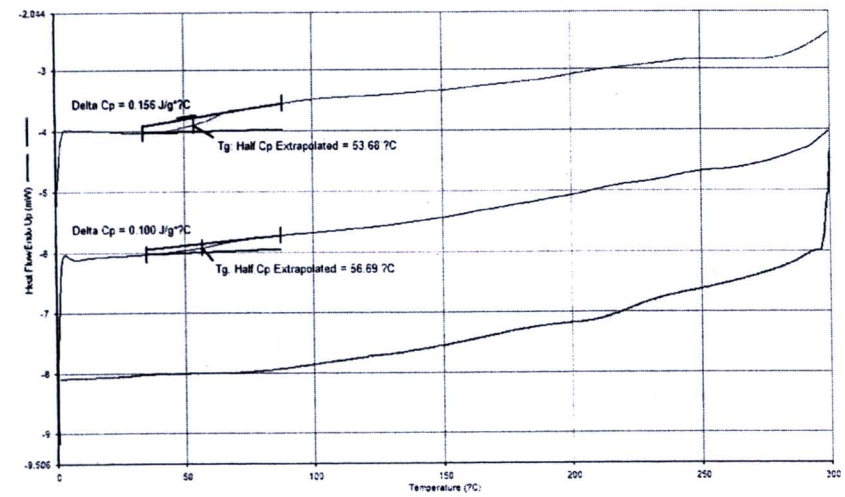
รูปที่ A.24 DSC curve of sPS3 / PBMA blends at composition 90/10 wt%



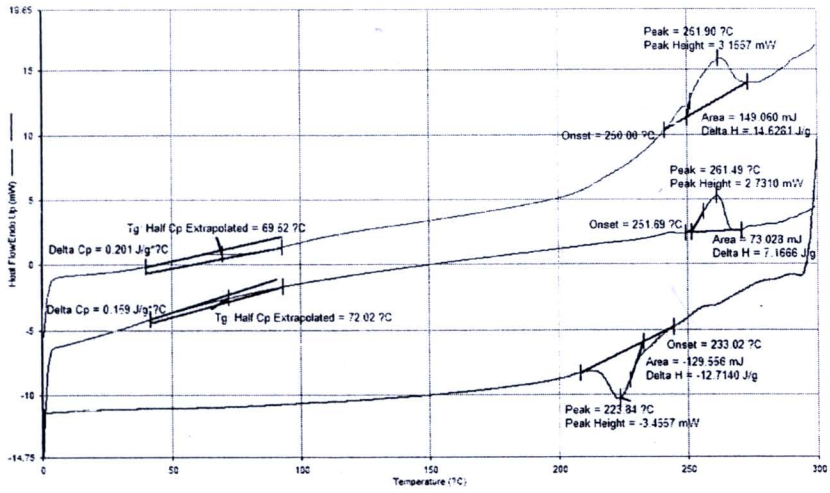
รูปที่ A.25 DSC curve of sPS1 / PCHA blends at composition 50/50 wt%



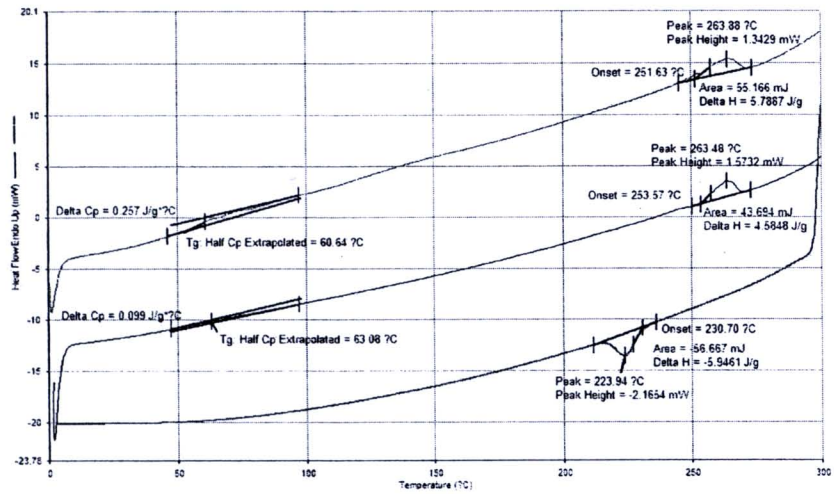
รูปที่ A.26 DSC curve of sPS2 / PCHA blends at composition 50/50 wt%



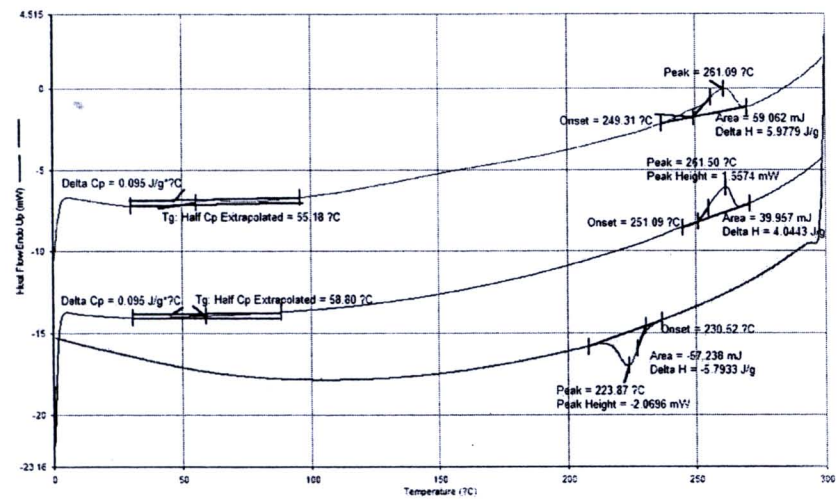
รูปที่ A.27 DSC curve of sPS3 / PCHA blends at composition 50/50 wt%



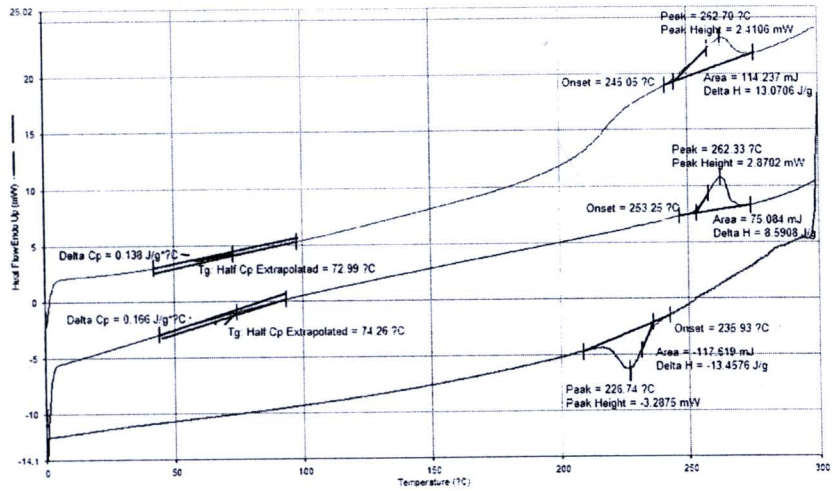
รูปที่ A.28 DSC curve of sPS1 / PCHA blends at composition 60/40 wt%



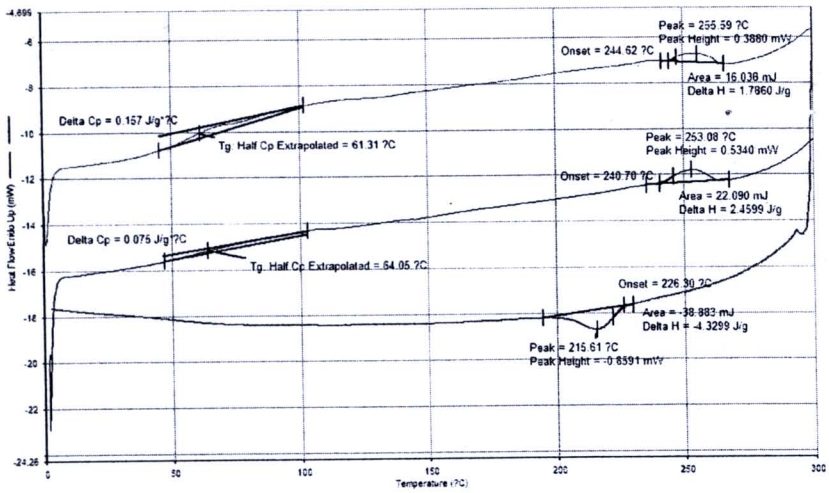
รูปที่ A.29 DSC curve of sPS2 / PCHA blends at composition 60/40 wt%



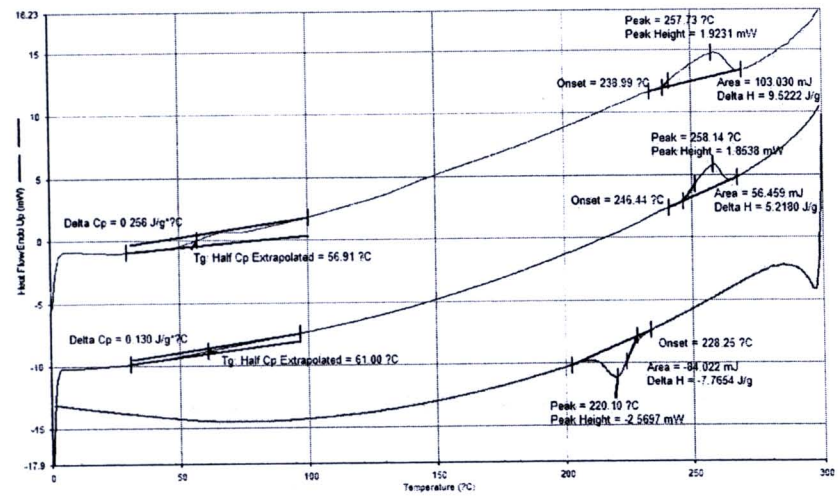
รูปที่ A.30 DSC curve of sPS3 / PCHA blends at composition 60/40 wt%



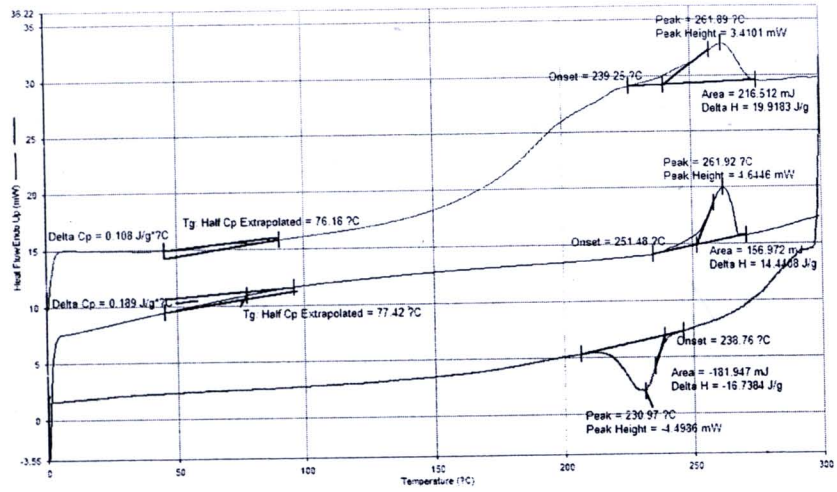
รูปที่ A.31 DSC curve of sPS1 / PCHA blends at composition 70/30 wt%



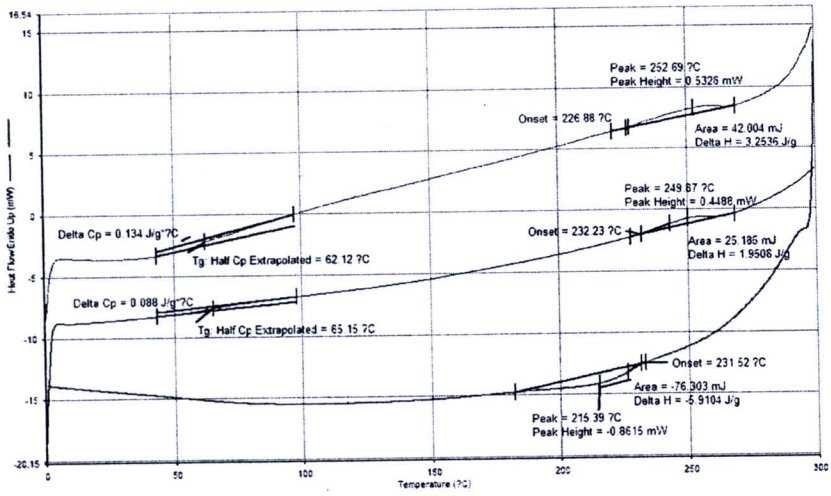
รูปที่ A.32 DSC curve of sPS2 / PCHA blends at composition 70/30 wt%



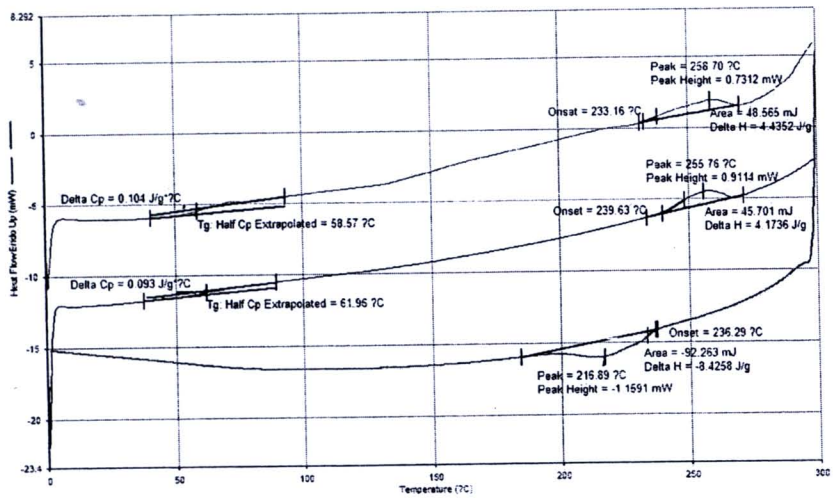
รูปที่ A.33 DSC curve of sPS3 / PCHA blends at composition 70/30 wt%



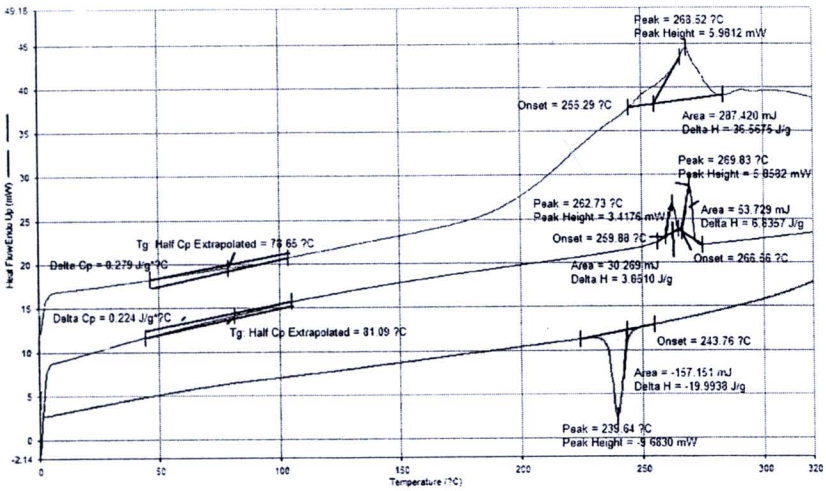
รูปที่ A.34 DSC curve of sPS1 / PCHA blends at composition 80/20 wt%



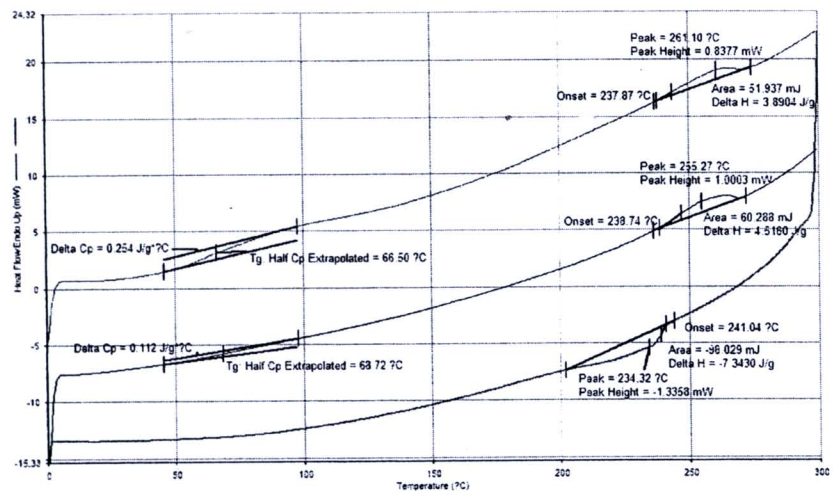
รูปที่ A.35 DSC curve of sPS2 / PCHA blends at composition 80/20 wt%



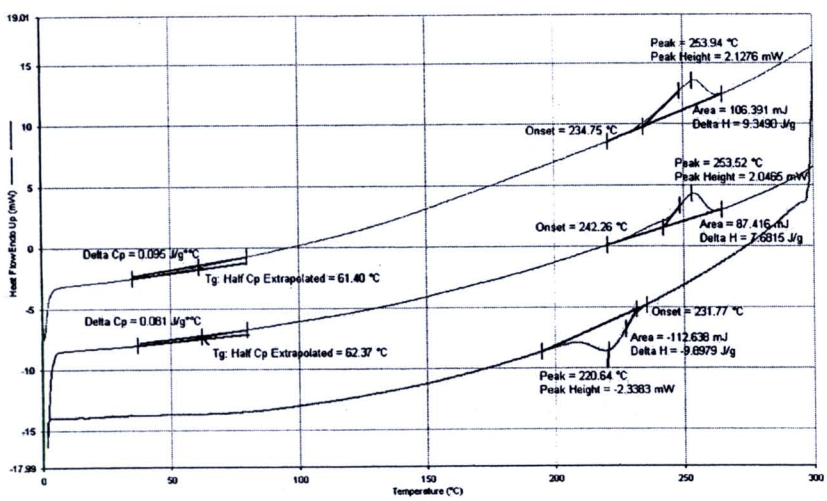
รูปที่ A.36 DSC curve of sPS3 / PCHA blends at composition 80/20 wt%



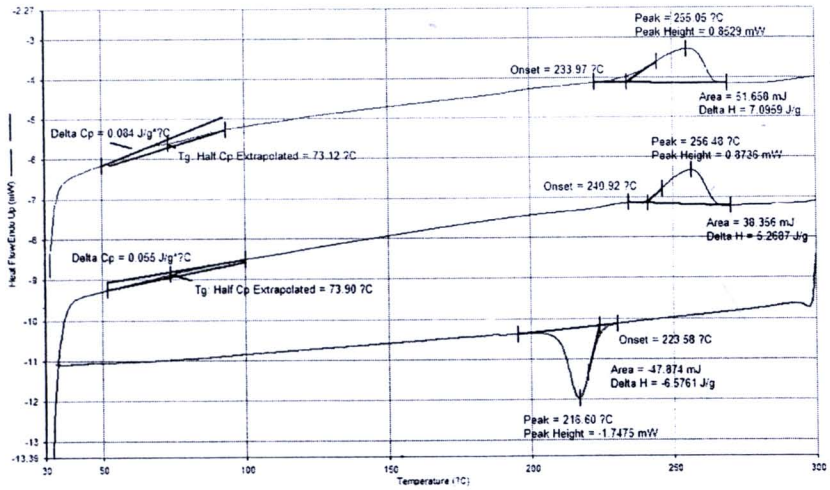
รูปที่ A.37 DSC curve of sPS1 / PCHA blends at composition 90/10 wt%



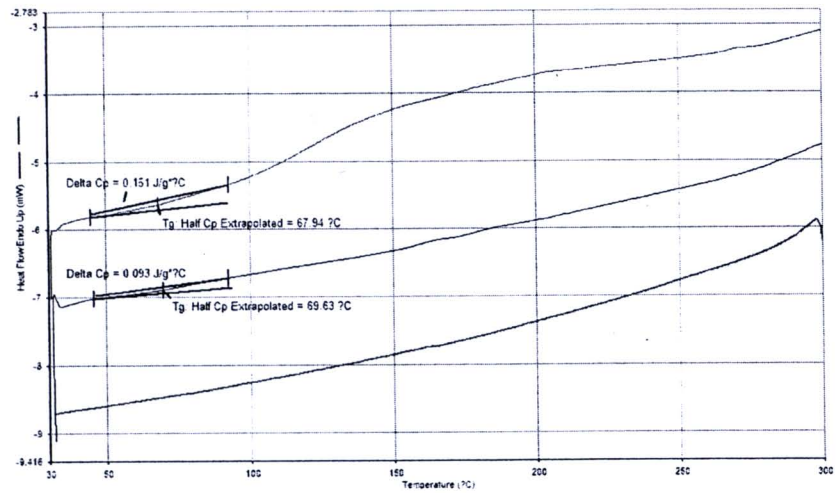
รูปที่ A.38 DSC curve of sPS2 / PCHA blends at composition 90/10 wt%



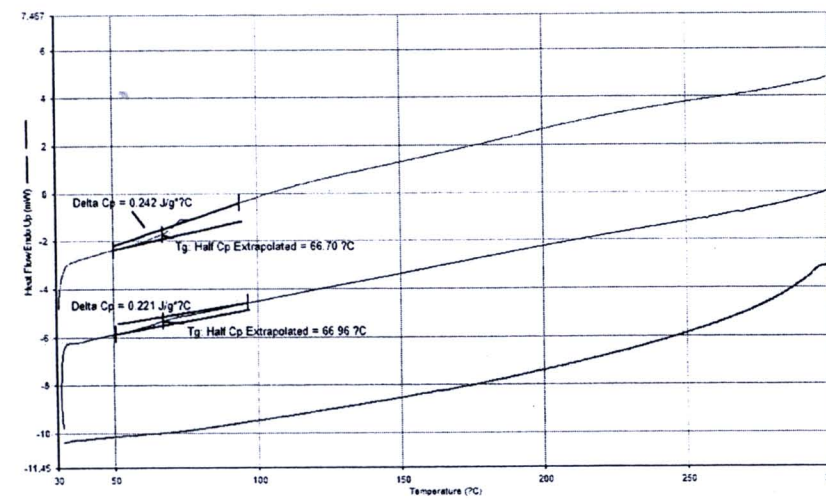
รูปที่ A.39 DSC curve of sPS3 / PCHA blends at composition 90/10 wt%



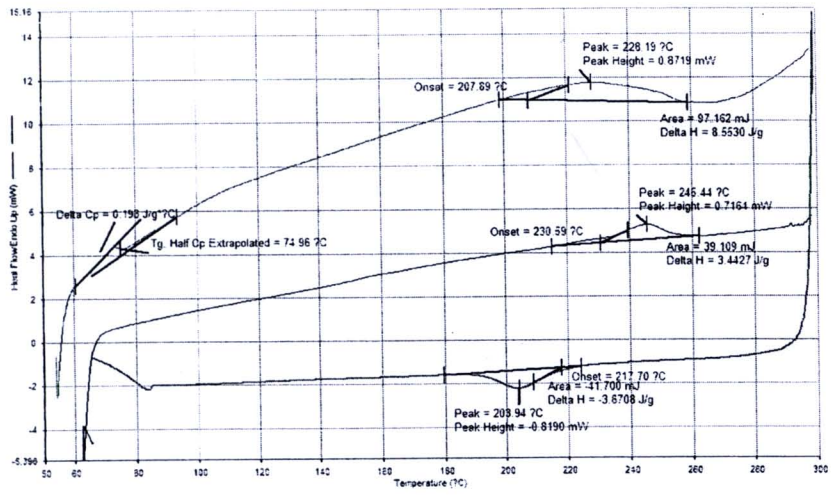
รูปที่ A.40 DSC curve of sPS1 / PEMA blends at composition 50/50 wt%



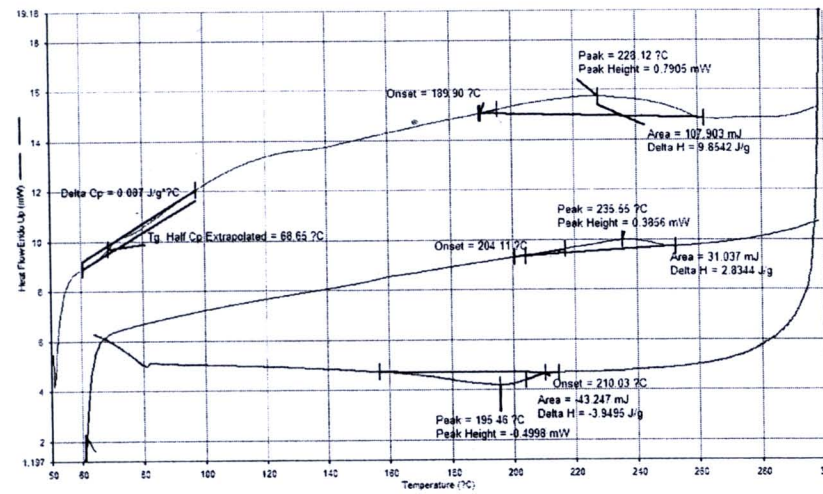
รูปที่ A.41 DSC curve of sPS2 / PEMA blends at composition 50/50 wt%



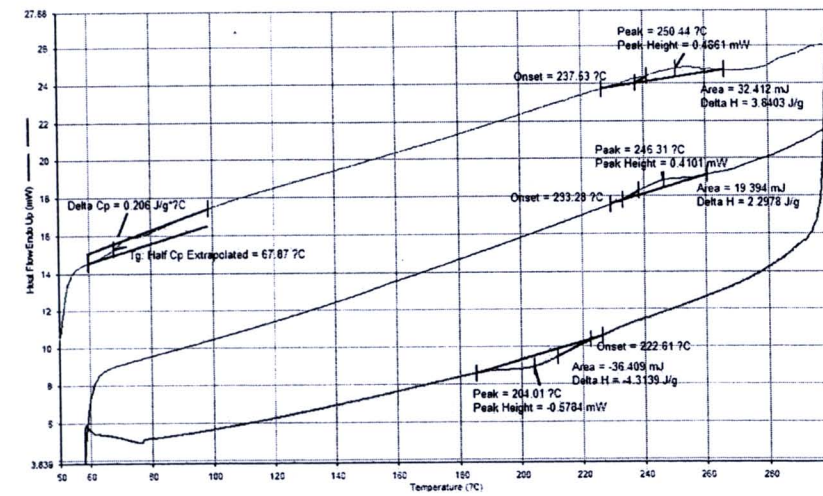
รูปที่ A.42 DSC curve of sPS3 / PEMA blends at composition 50/50 wt%



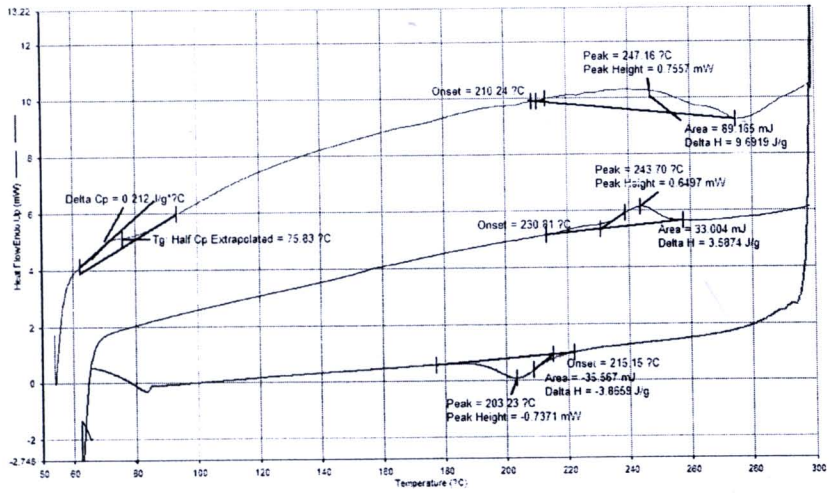
รูปที่ A.43 DSC curve of sPS1 / PEMA blends at composition 60/40 wt%



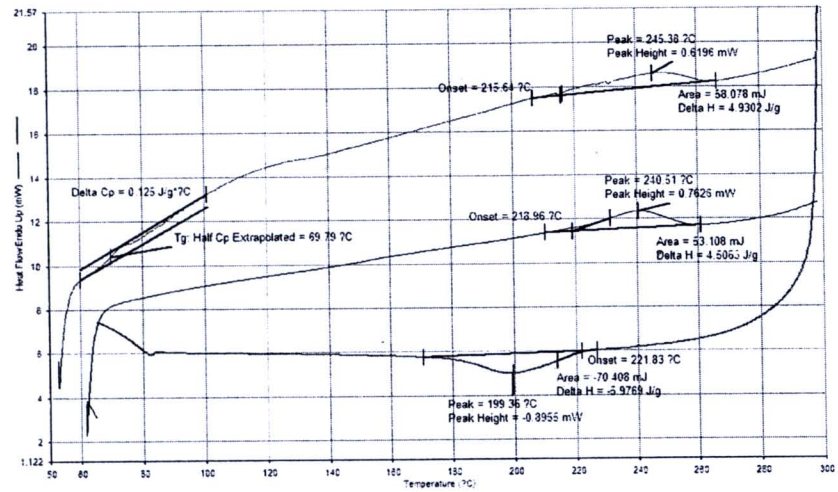
รูปที่ A.44 DSC curve of sPS2 / PEMA blends at composition 60/40 wt%



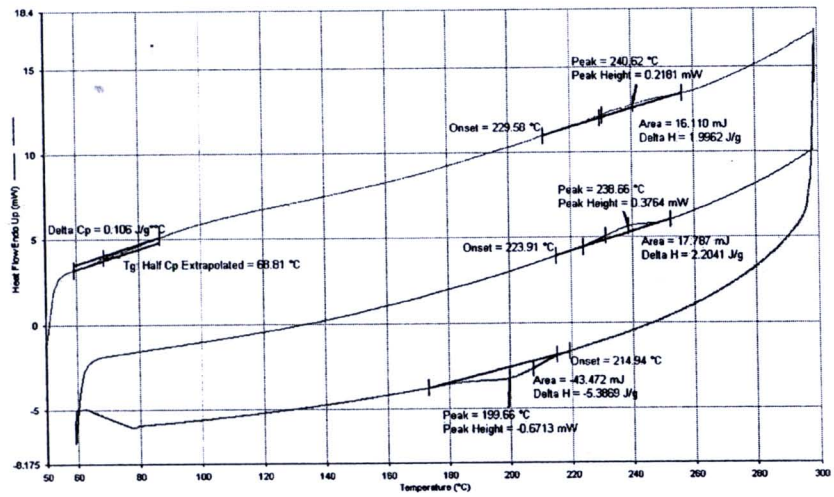
รูปที่ A.45 DSC curve of sPS3 / PEMA blends at composition 60/40 wt%



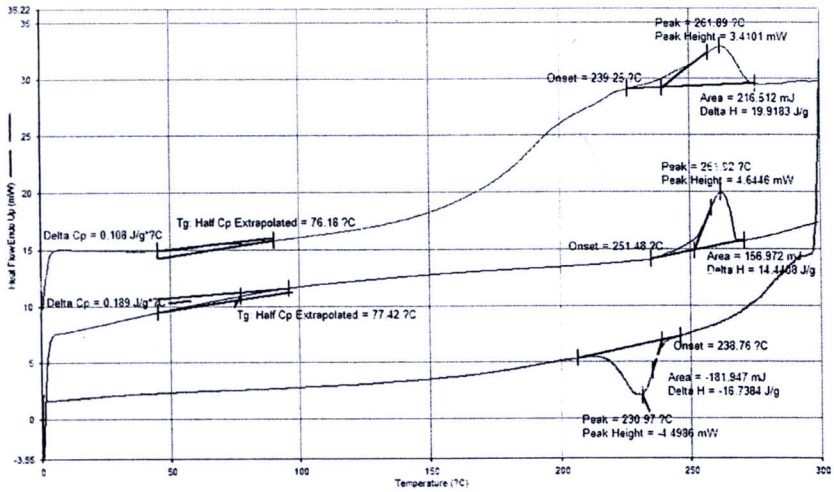
รูปที่ A.46 DSC curve of sPS1 / PEMA blends at composition 70/30 wt%



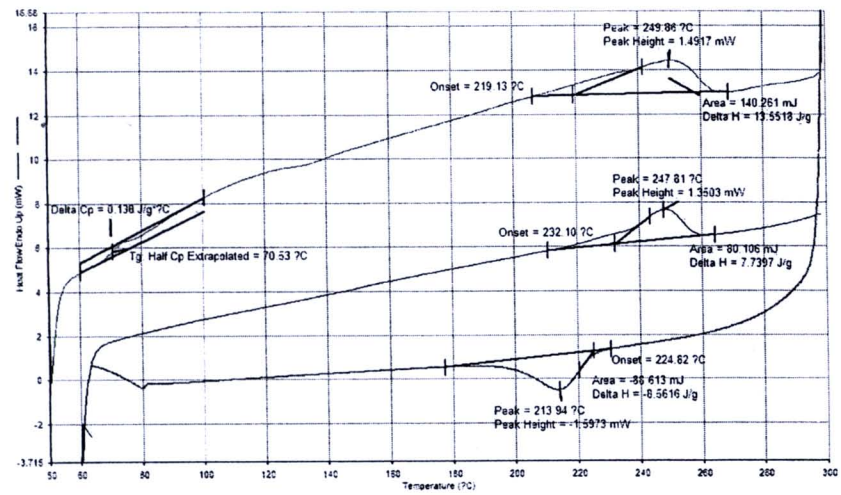
รูปที่ A.47 DSC curve of sPS2 / PEMA blends at composition 70/30 wt%



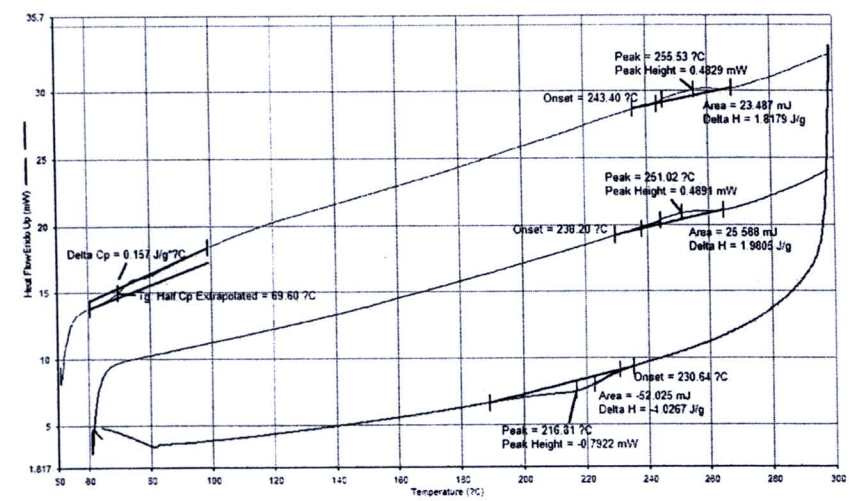
รูปที่ A.48 DSC curve of sPS3 / PEMA blends at composition 70/30 wt%



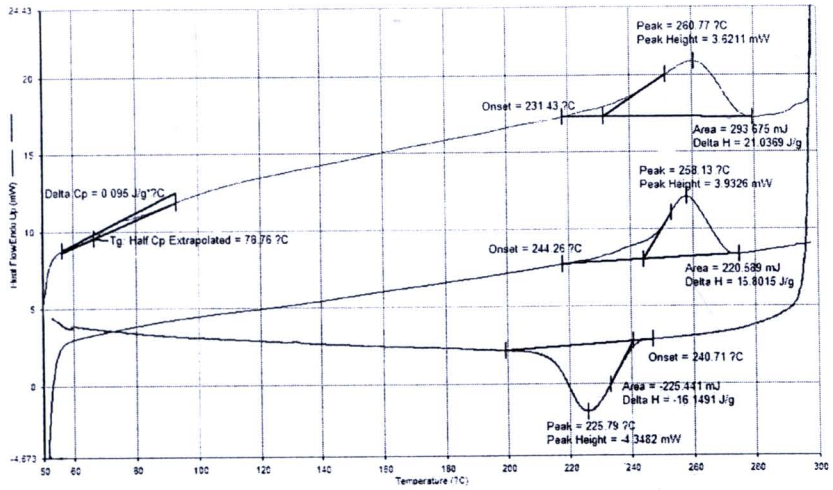
รูปที่ A.49 DSC curve of sPS1 / PEMA blends at composition 80/20 wt%



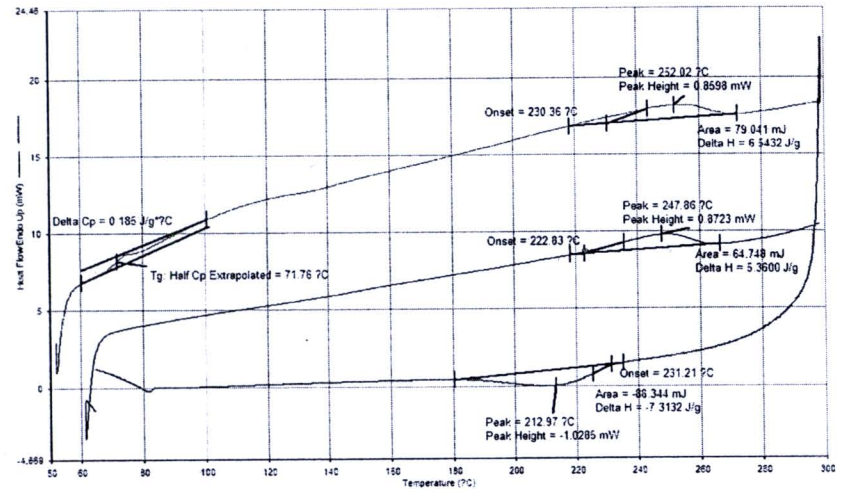
รูปที่ A.50 DSC curve of sPS2 / PEMA blends at composition 80/20 wt%



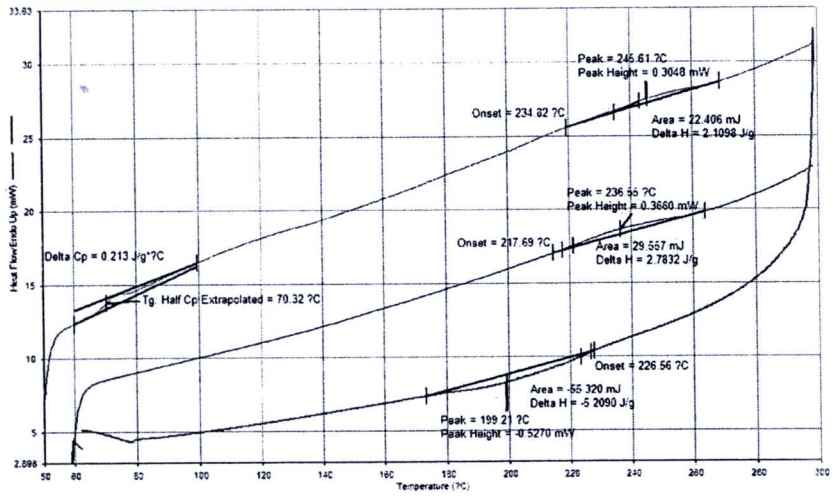
รูปที่ A.51 DSC curve of sPS3 / PEMA blends at composition 80/20 wt%



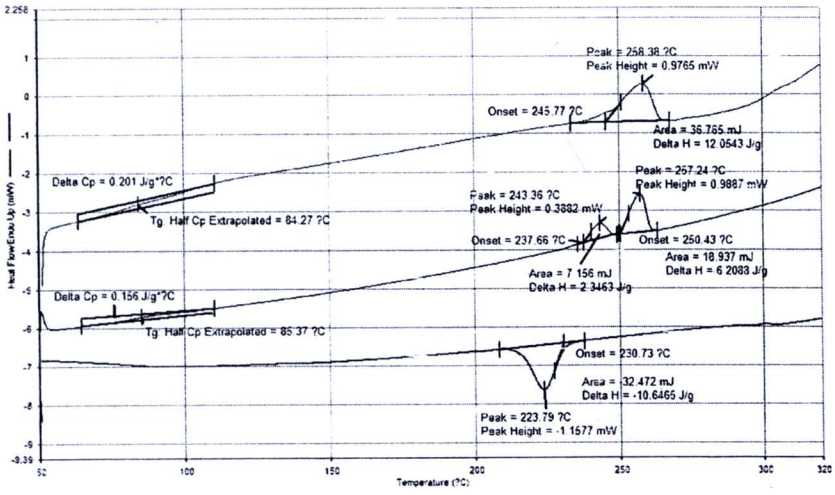
รูปที่ A.52 DSC curve of sPS1 / PEMA blends at composition 90/10 wt%



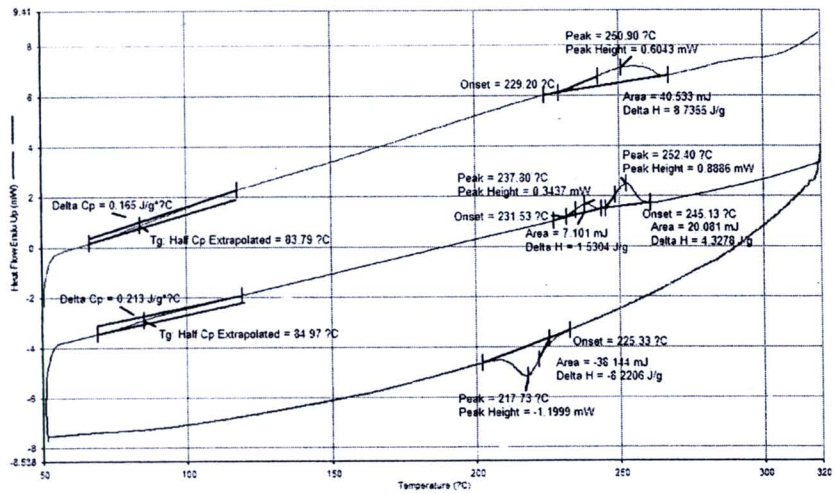
รูปที่ A.53 DSC curve of sPS2 / PEMA blends at composition 90/10 wt%



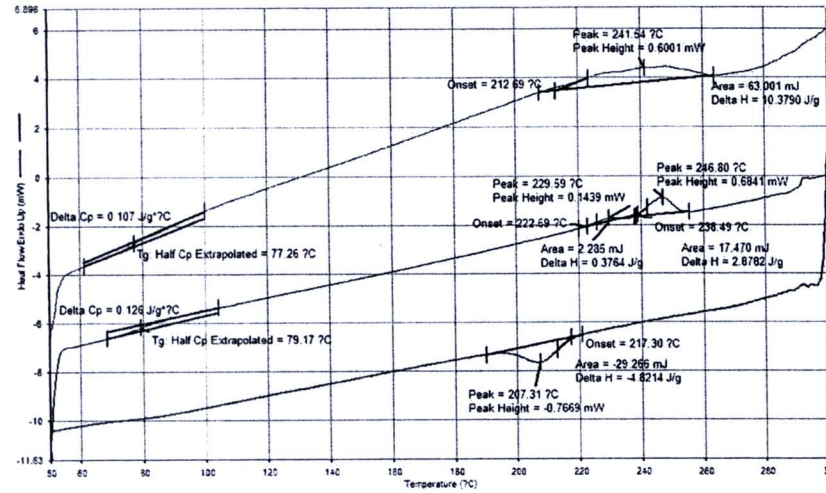
รูปที่ A.54 DSC curve of sPS3 / PEMA blends at composition 90/10 wt%



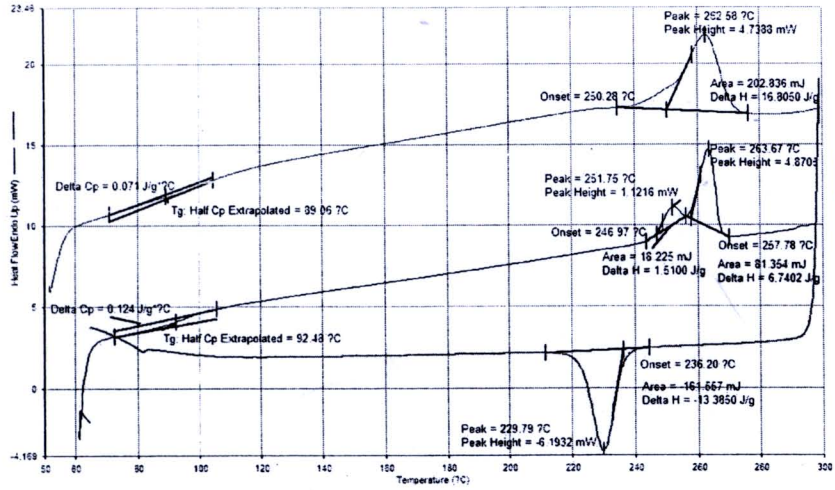
รูปที่ A.55 DSC curve of sPS1 / Poly(α-methylstyrene) blends at composition 50/50 wt%



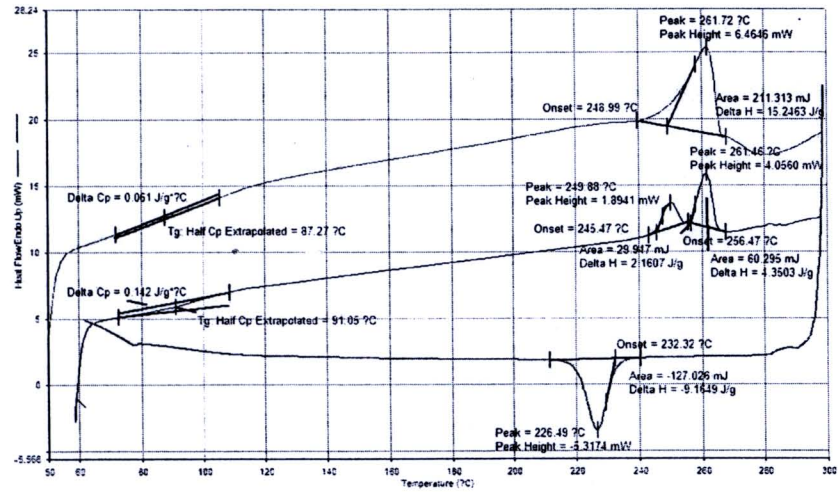
รูปที่ A.56 DSC curve of sPS2 / Poly(α-methylstyrene) blends at composition 50/50 wt%



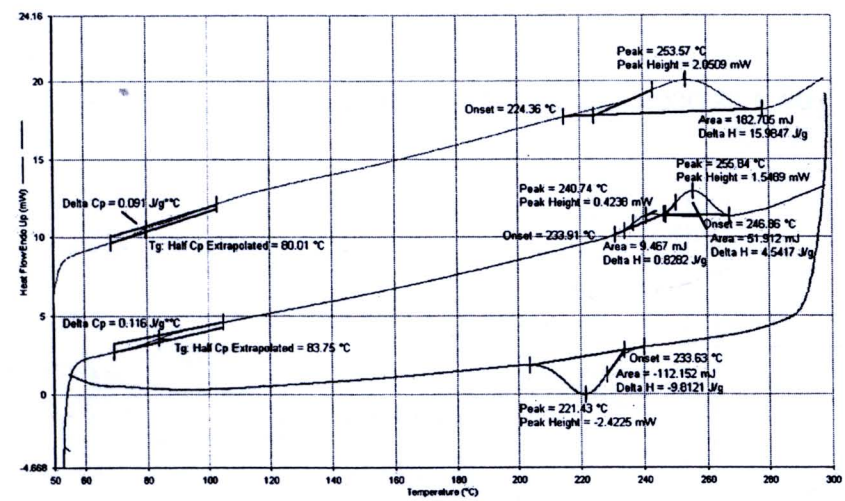
รูปที่ A.57 DSC curve of sPS3 / Poly(α-methylstyrene) blends at composition 50/50 wt%



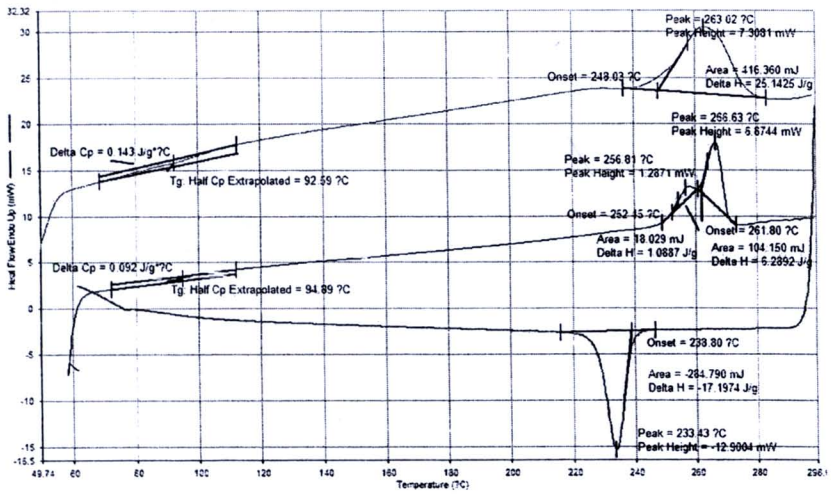
รูปที่ A.58 DSC curve of sPS1 / Poly(α-methylstyrene) blends at composition 60/40 wt%



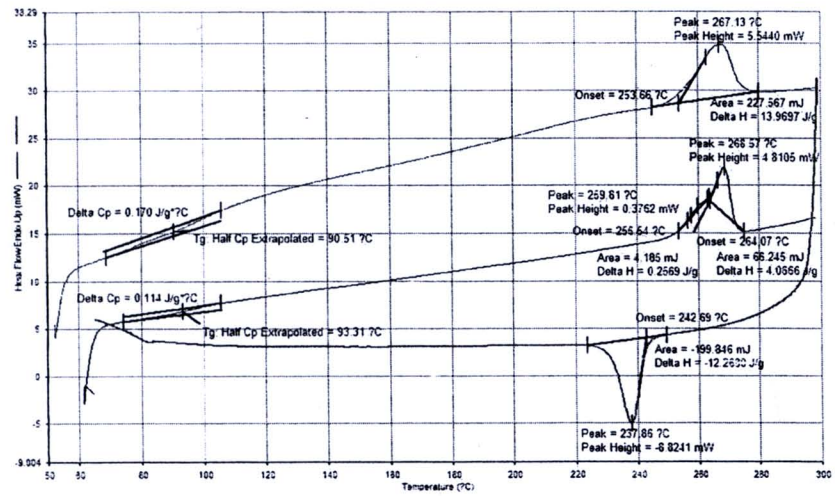
รูปที่ A.59 DSC curve of sPS2 / Poly(α-methylstyrene) blends at composition 60/40 wt%



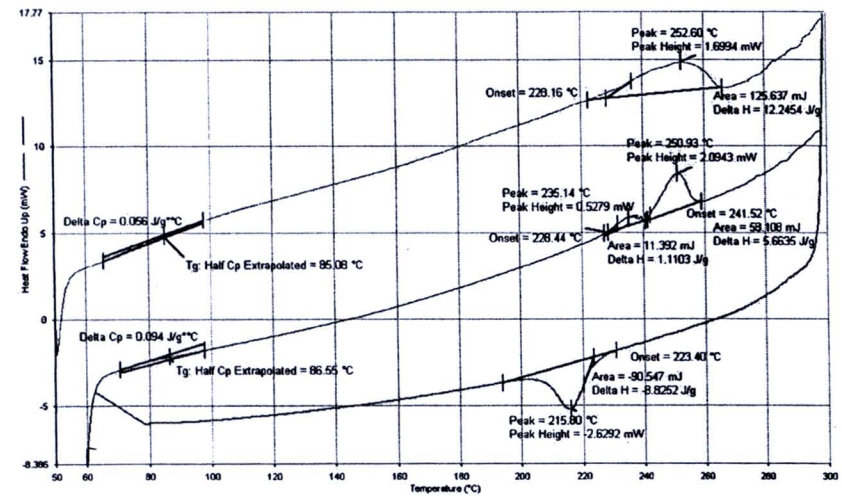
รูปที่ A.60 DSC curve of sPS3 / Poly(α-methylstyrene) blends at composition 60/40 wt%



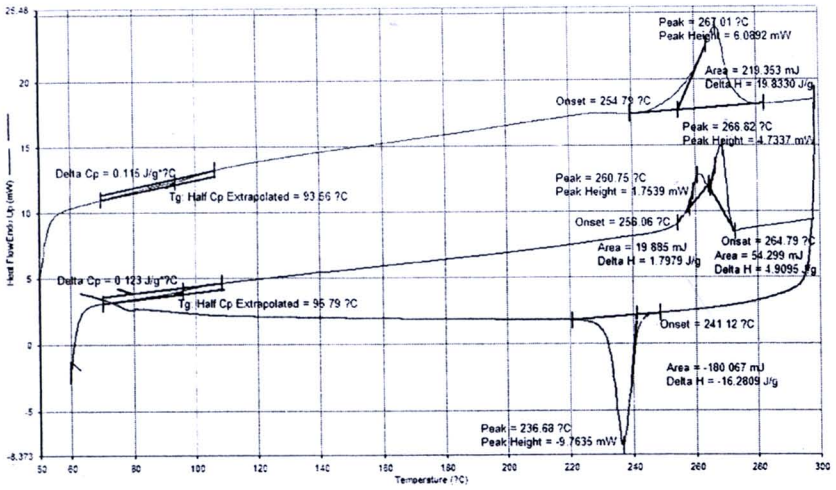
รูปที่ A.61 DSC curve of sPS1 / Poly(α-methylstyrene) blends at composition 70/30 wt%



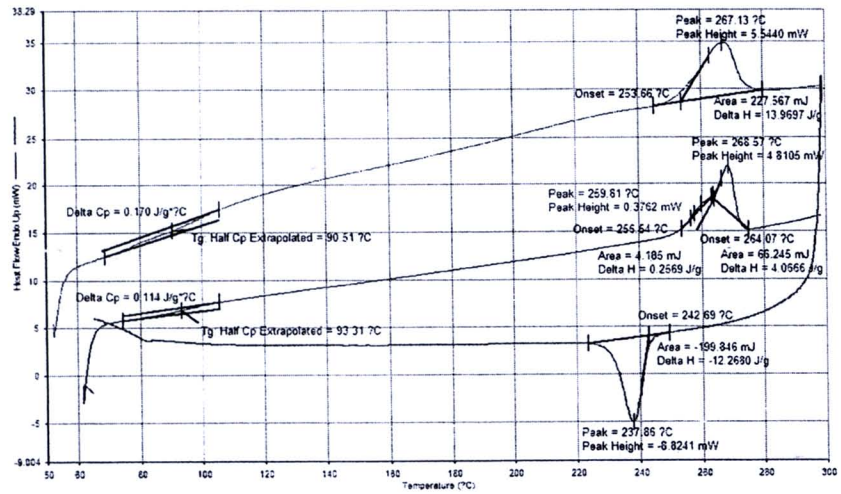
รูปที่ A.62 DSC curve of sPS2 / Poly(α-methylstyrene) blends at composition 70/30 wt%



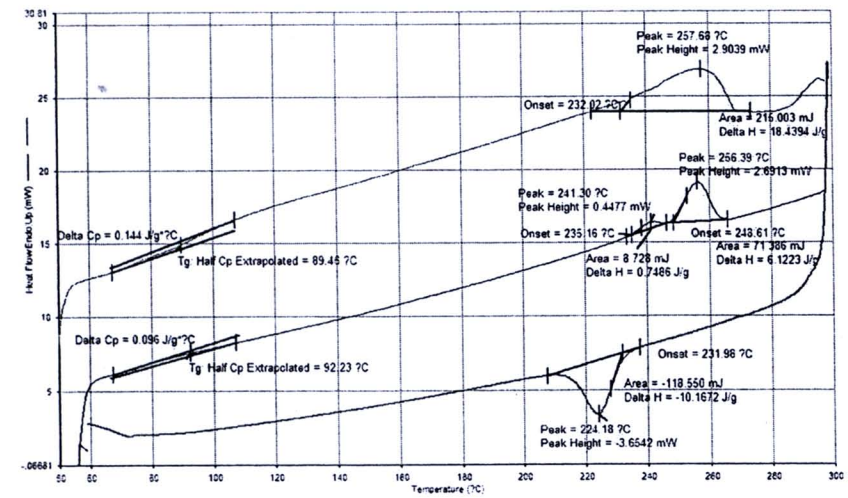
รูปที่ A.63 DSC curve of sPS3 / Poly(α-methylstyrene) blends at composition 70/30 wt%



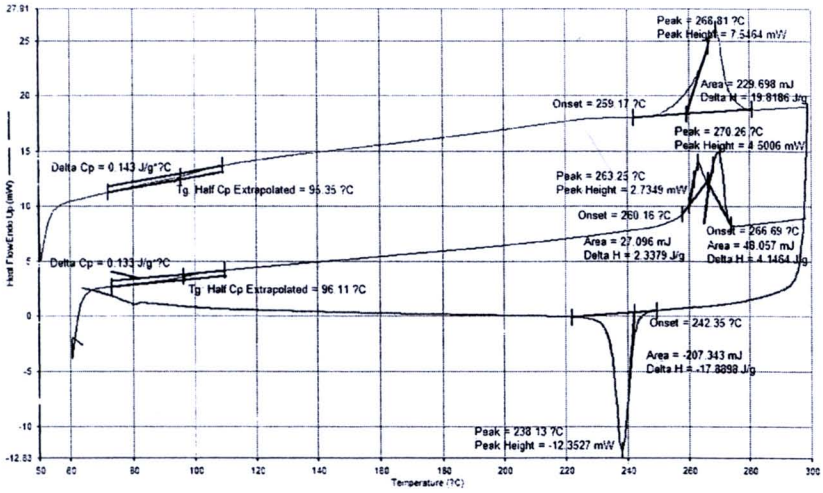
รูปที่ A.64 DSC curve of sPS1 / Poly(α-methylstyrene) blends at composition 80/20 wt%



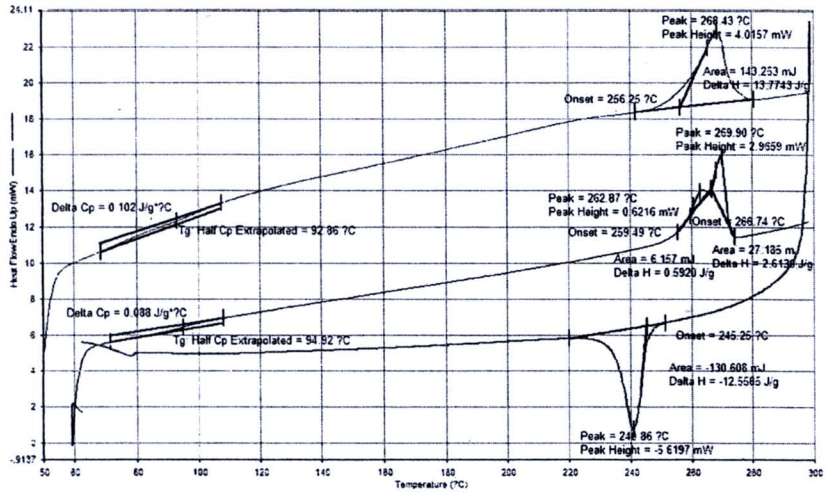
รูปที่ A.65 DSC curve of sPS2 / Poly(α-methylstyrene) blends at composition 80/20 wt%



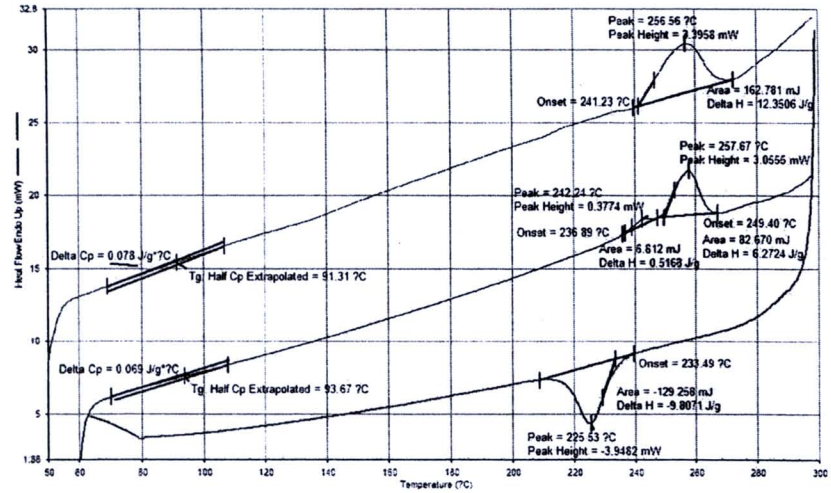
รูปที่ A.66 DSC curve of sPS3 / Poly(α-methylstyrene) blends at composition 80/20 wt%



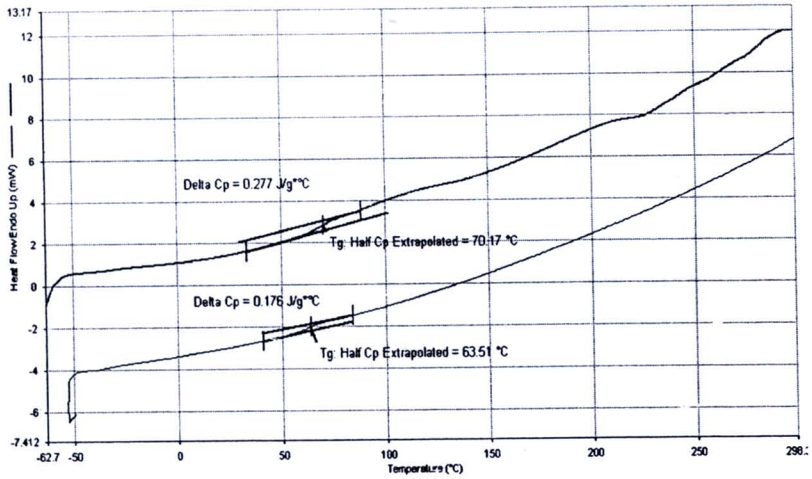
รูปที่ A.67 DSC curve of sPS1 / Poly(α-methylstyrene) blends at composition 90/10 wt%



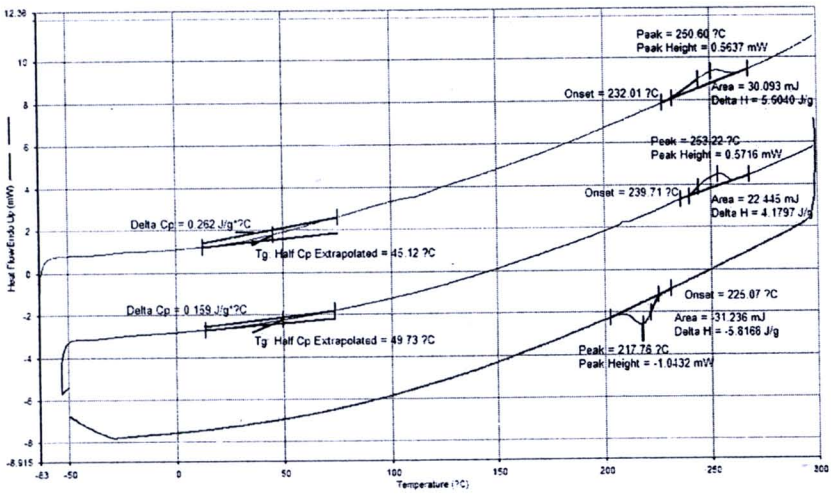
รูปที่ A.68 DSC curve of sPS2 / Poly(α-methylstyrene) blends at composition 90/10 wt%



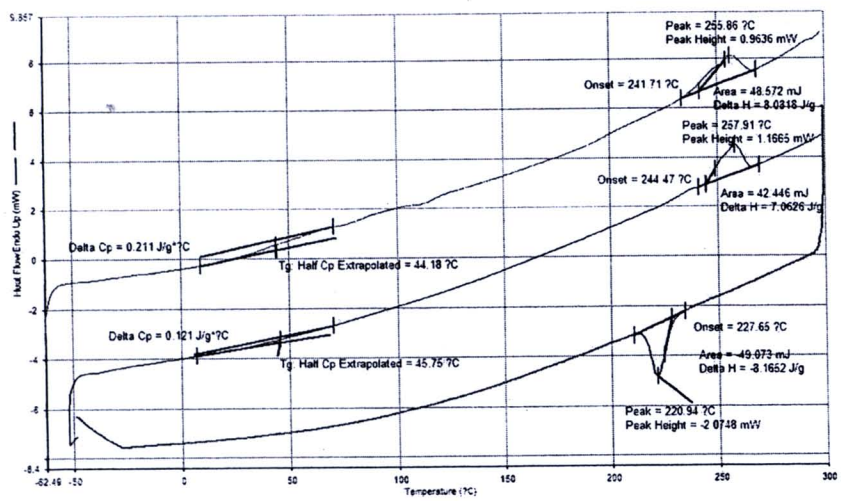
รูปที่ A.69 DSC curve of sPS3 / Poly(α-methylstyrene) blends at composition 90/10 wt%



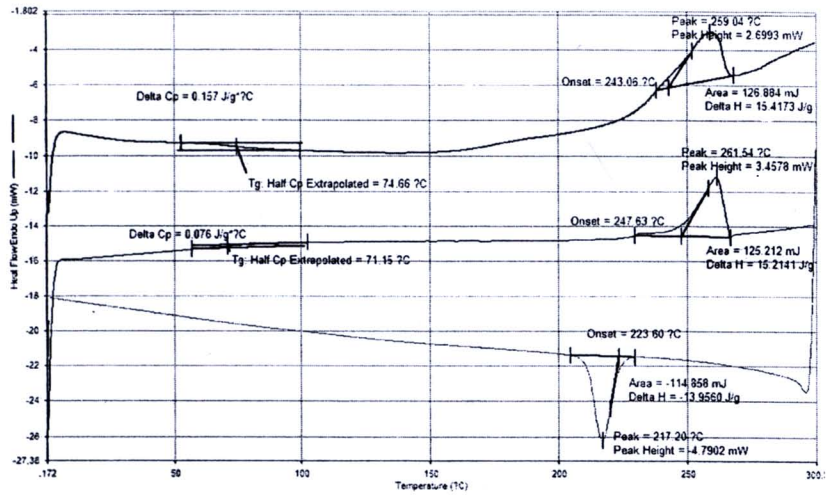
รูปที่ A.70 DSC curve of sPS1 / Polyisoprene blends at composition 50/50 wt%



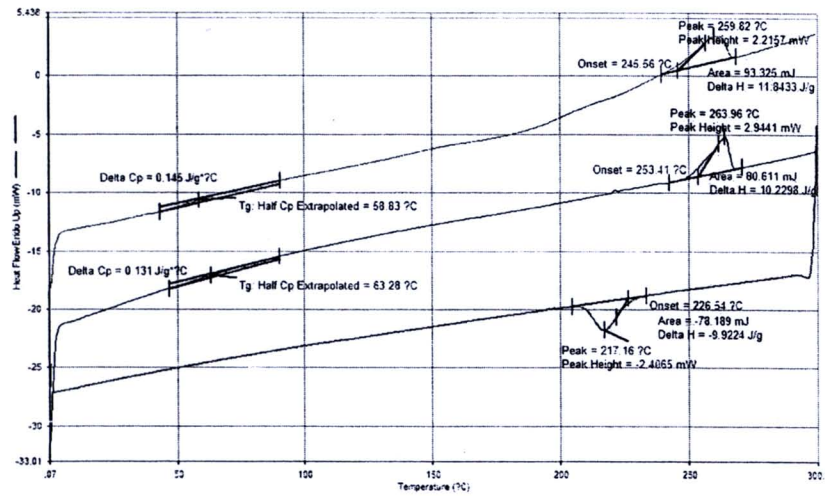
รูปที่ A.71 DSC curve of sPS2 / Polyisoprene blends at composition 50/50 wt%



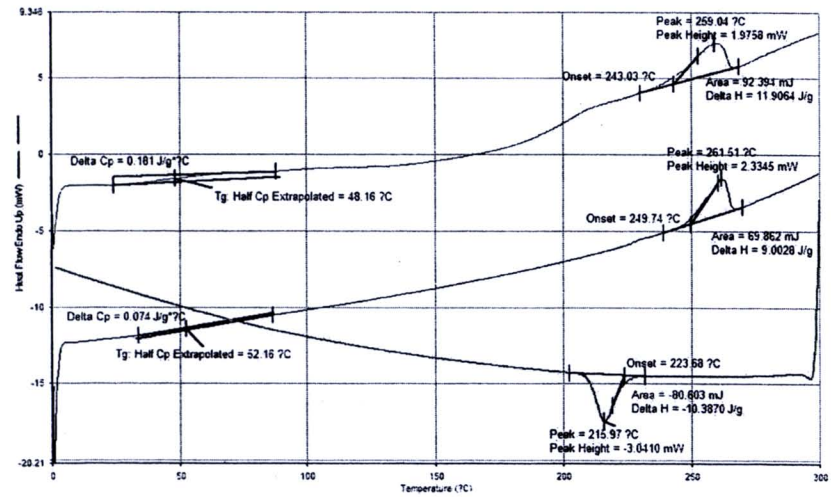
รูปที่ A.72 DSC curve of sPS3 / Polyisoprene blends at composition 50/50 wt%



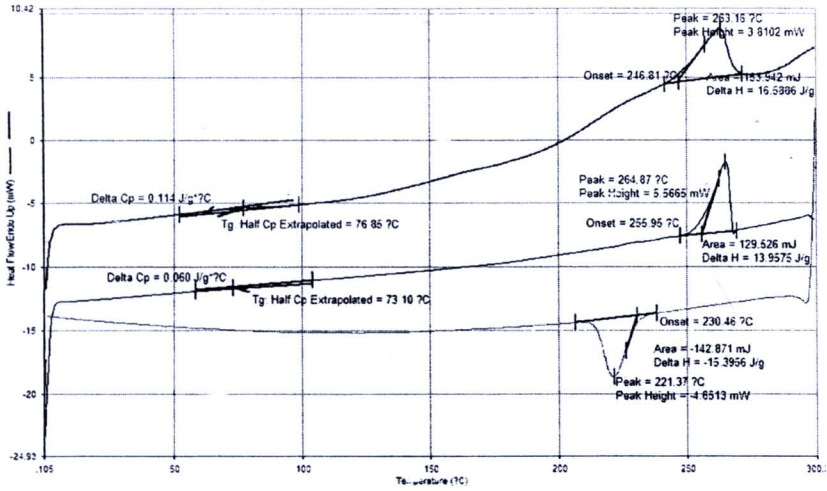
รูปที่ A.73 DSC curve of sPS1 / Polyisoprene blends at composition 60/40 wt%



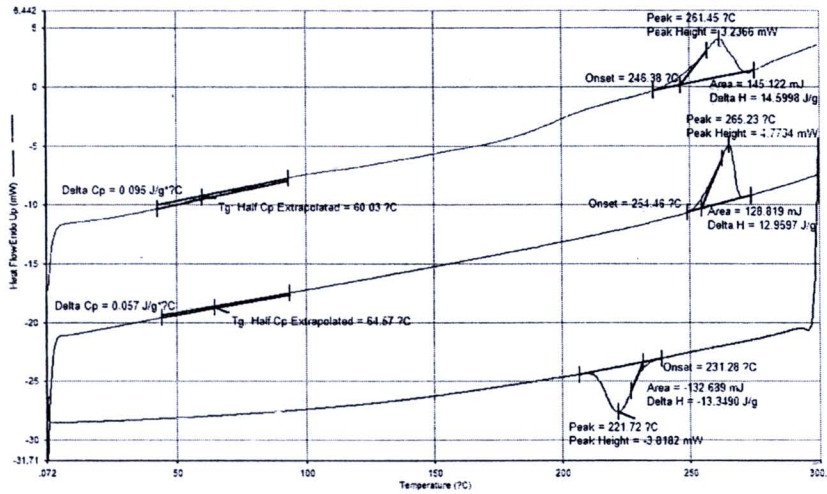
รูปที่ A.74 DSC curve of sPS2 / Polyisoprene blends at composition 60/40 wt%



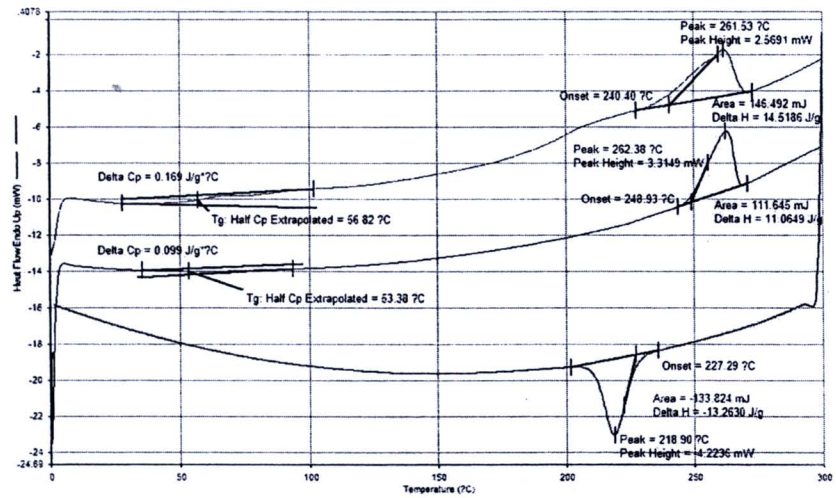
รูปที่ A.75 DSC curve of sPS3 / Polyisoprene blends at composition 60/40 wt%



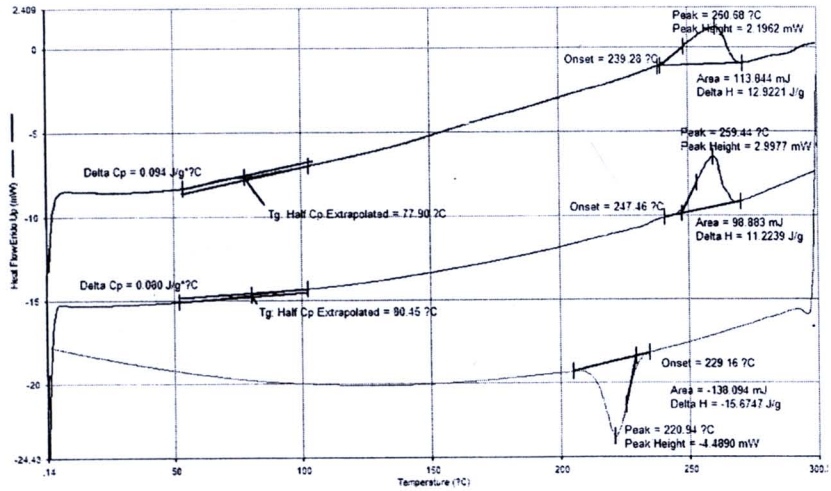
รูปที่ A.76 DSC curve of sPS1 / Polyisoprene blends at composition 70/30 wt%



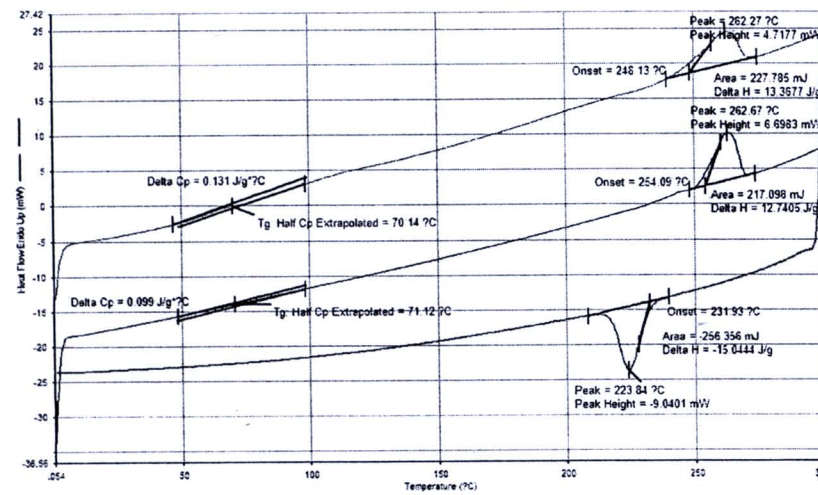
รูปที่ A.77 DSC curve of sPS2 / Polyisoprene blends at composition 70/30 wt%



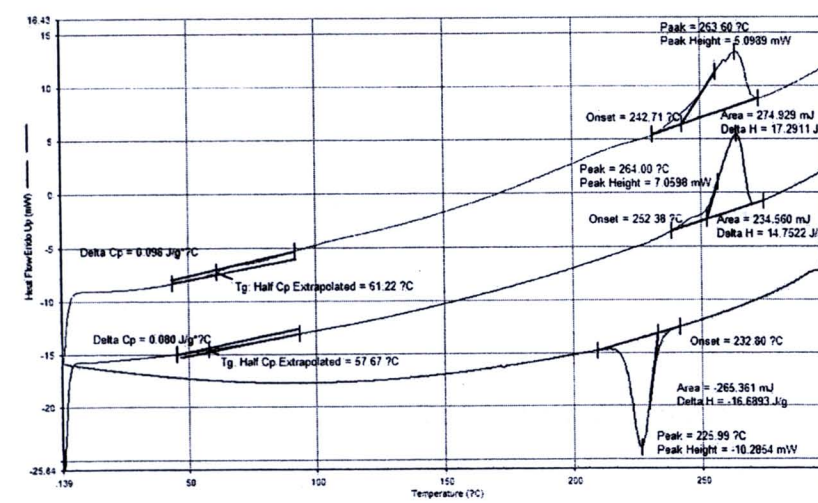
รูปที่ A.78 DSC curve of sPS3 / Polyisoprene blends at composition 70/30 wt%



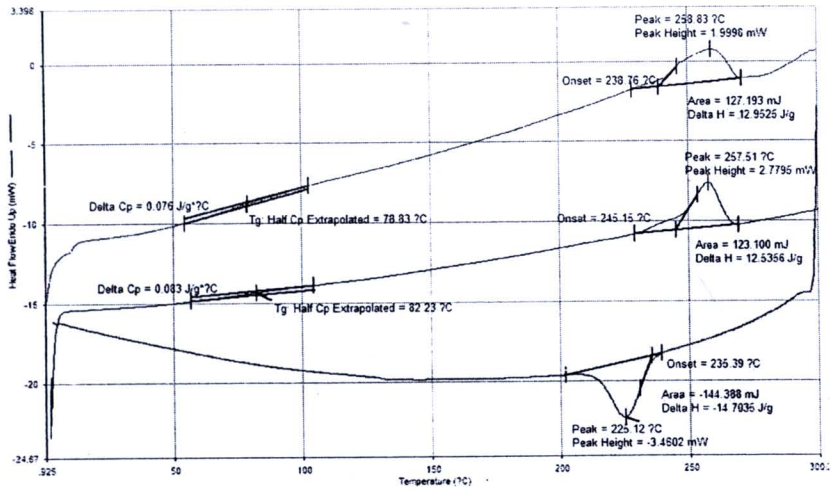
รูปที่ A.79 DSC curve of sPS1 / Polyisoprene blends at composition 80/20 wt%



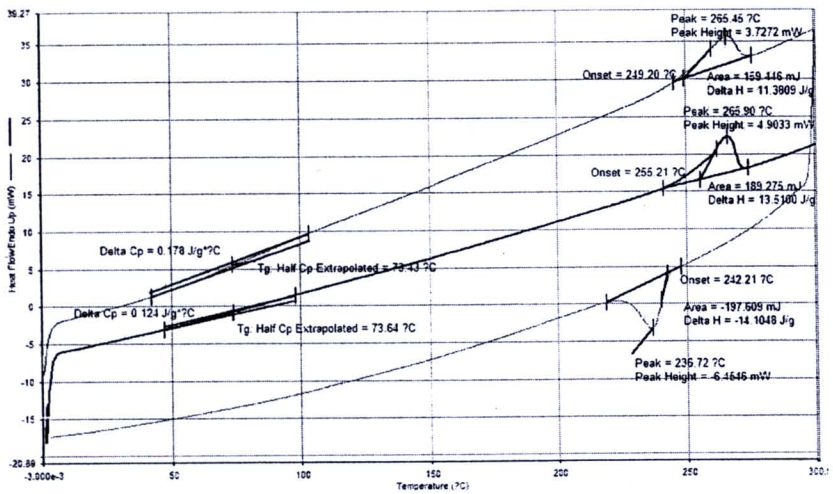
รูปที่ A.80 DSC curve of sPS2 / Polyisoprene blends at composition 80/20 wt%



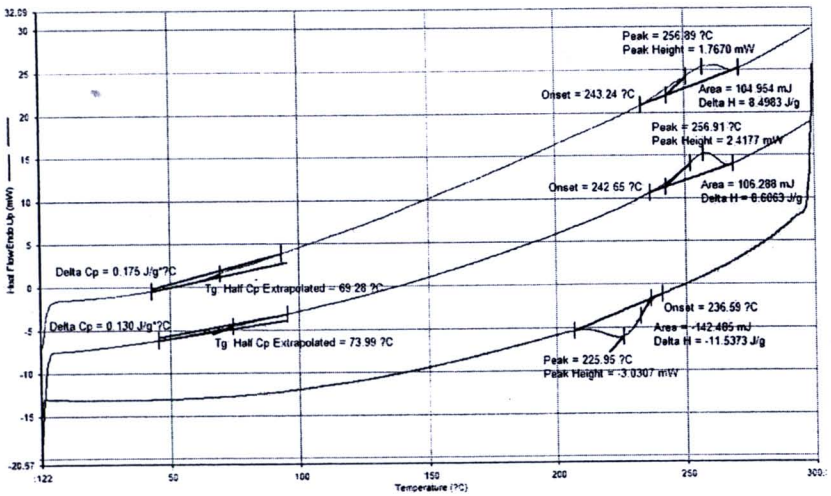
รูปที่ A.81 DSC curve of sPS3 / Polyisoprene blends at composition 80/20 wt%



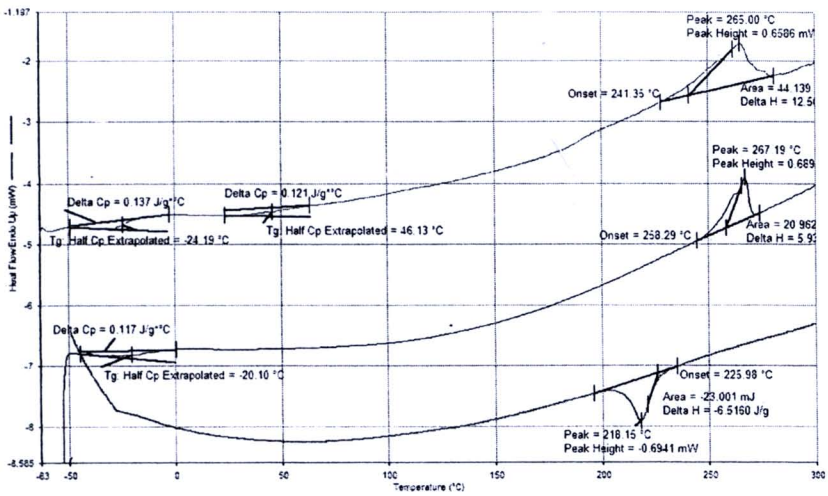
รูปที่ A.82 DSC curve of sPS1 / Polyisoprene blends at composition 90/10 wt%



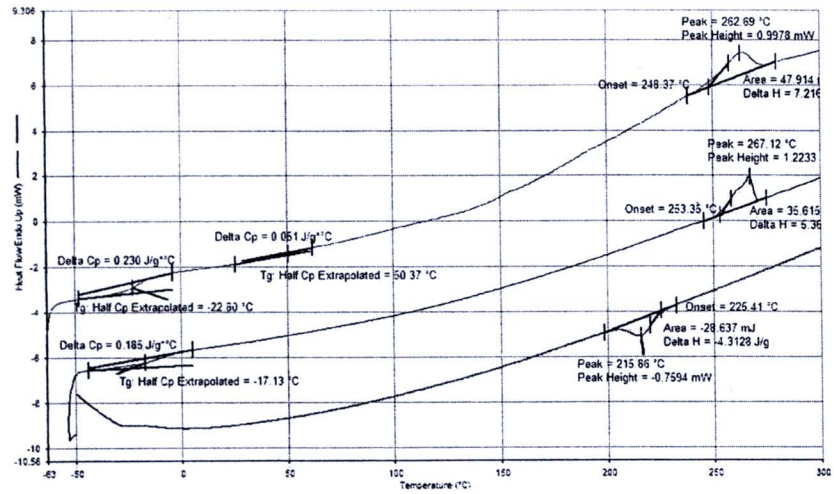
รูปที่ A.83 DSC curve of sPS2 / Polyisoprene blends at composition 90/10 wt%



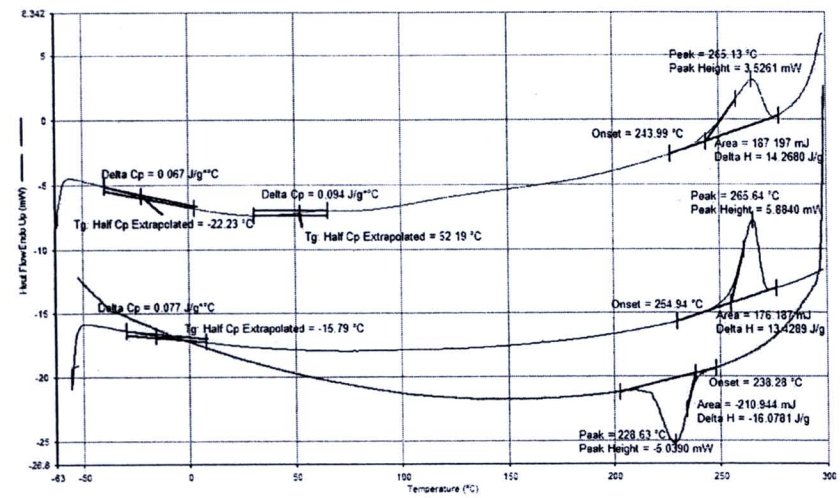
รูปที่ A.84 DSC curve of sPS3 / Polyisoprene blends at composition 90/10 wt%



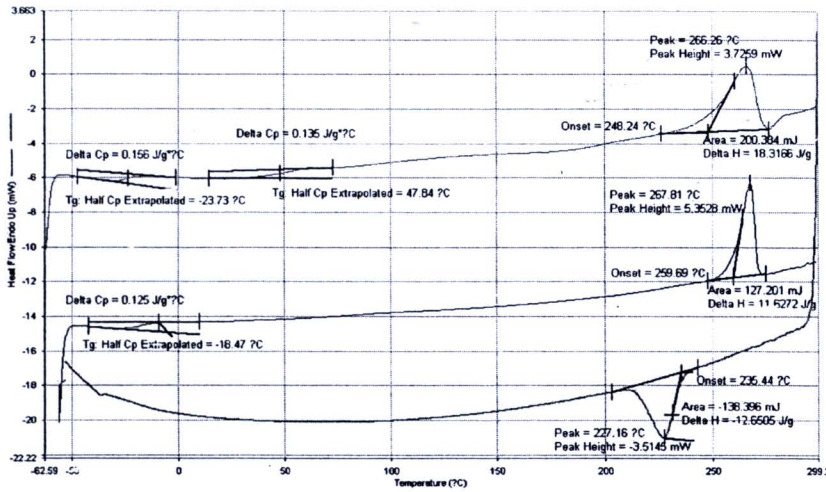
รูปที่ A.85 DSC curve of sPS1 / PVME blends at composition 50/50 wt%



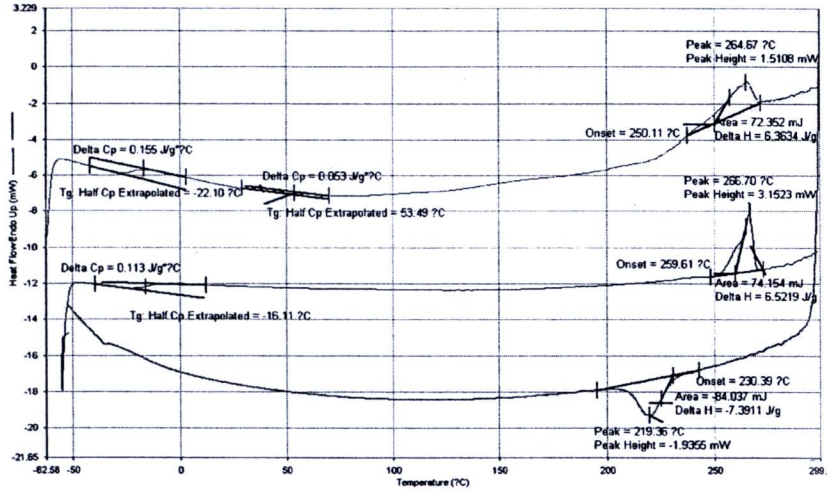
รูปที่ A.86 DSC curve of sPS2 / PVME blends at composition 50/50 wt%



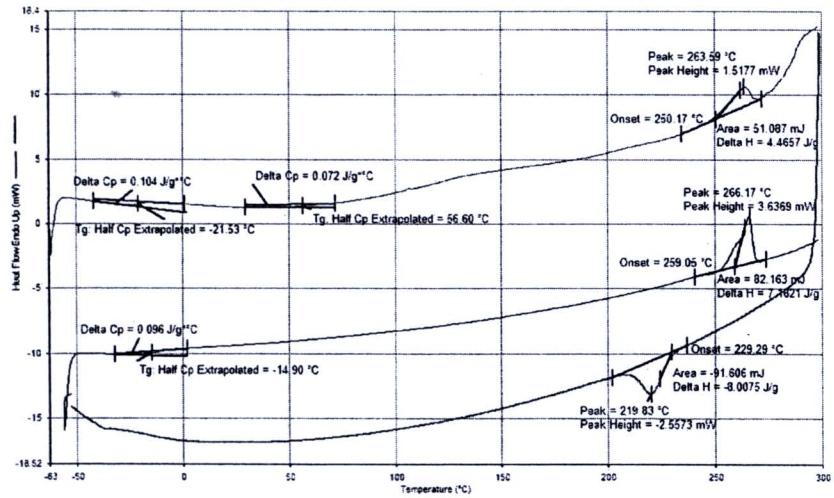
รูปที่ A.87 DSC curve of sPS3 / PVME blends at composition 50/50 wt%



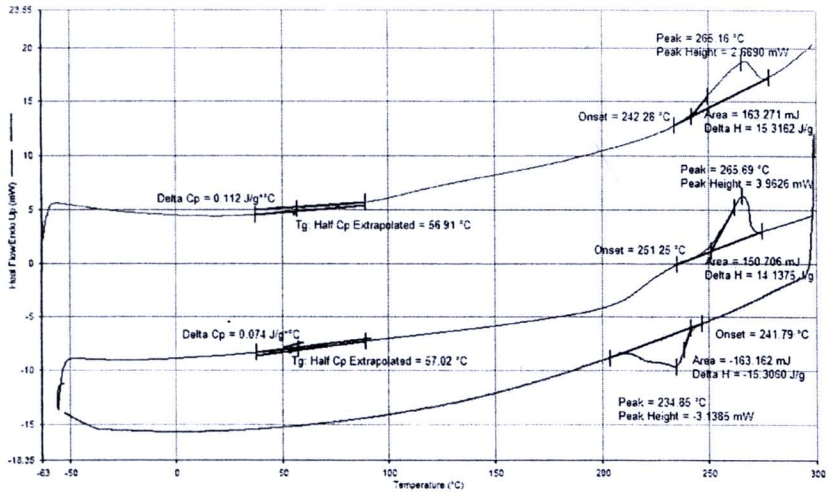
รูปที่ A.88 DSC curve of sPS1 / PVME blends at composition 60/40 wt%



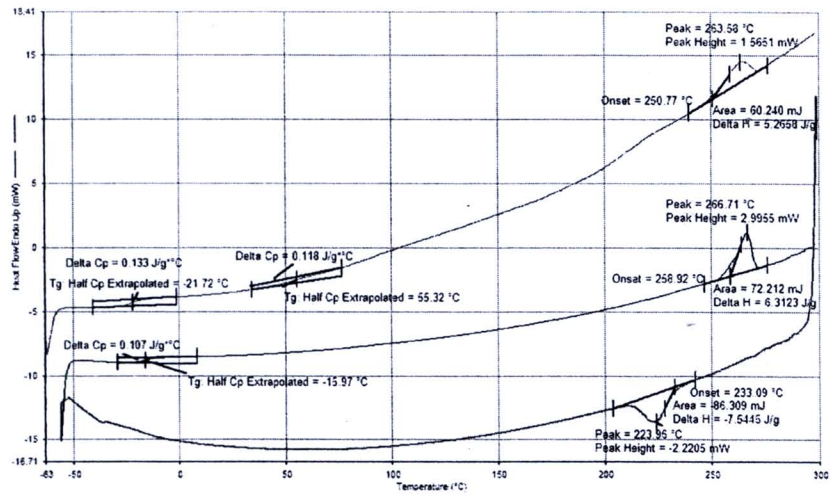
รูปที่ A.89 DSC curve of sPS2 / PVME blends at composition 60/40 wt%



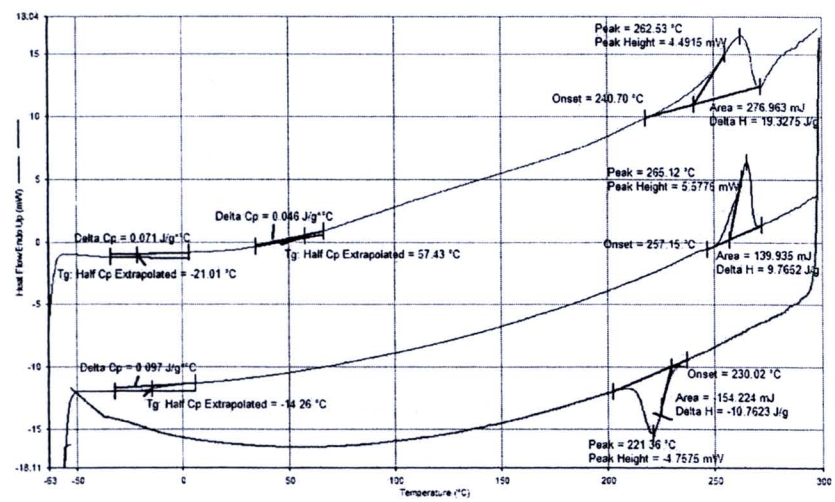
รูปที่ A.90 DSC curve of sPS3 / PVME blends at composition 60/40 wt%



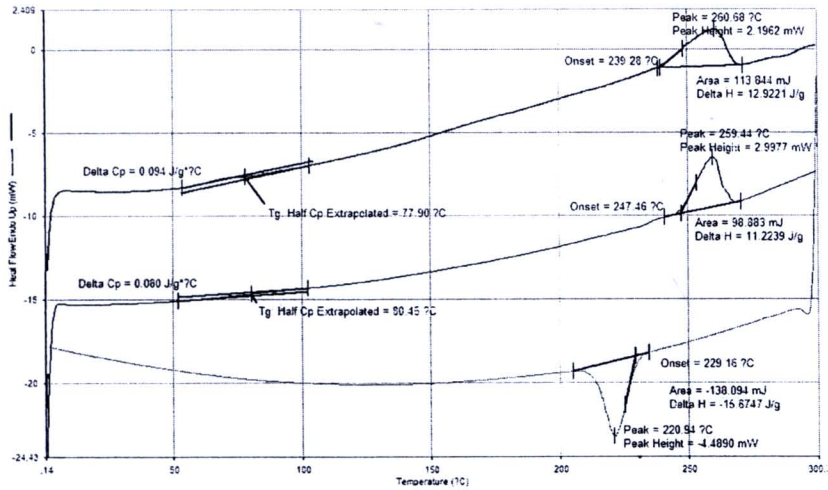
รูปที่ A.91 DSC curve of sPS1 / Polyisoprene blends at composition 70/30 wt%



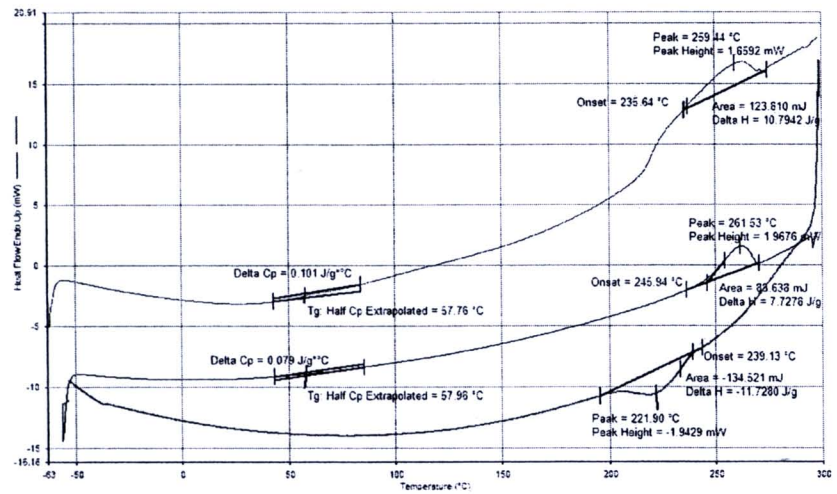
รูปที่ A.92 DSC curve of sPS2 / PVME blends at composition 70/30 wt%



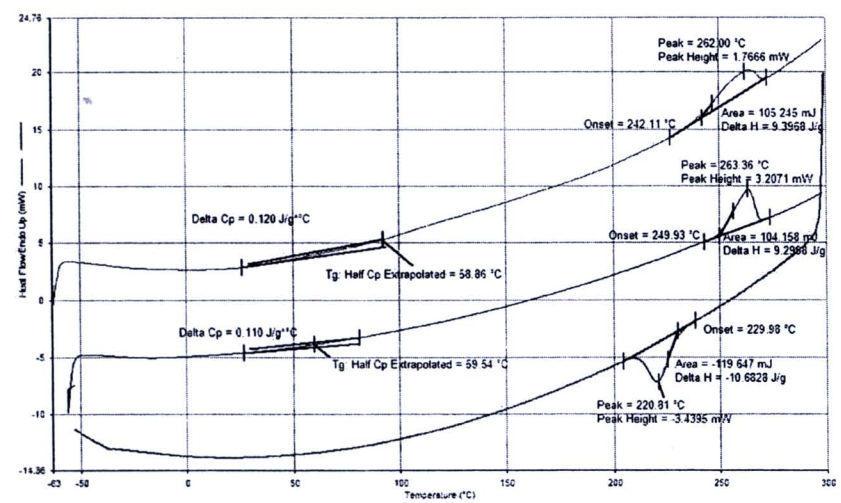
รูปที่ A.93 DSC curve of sPS3 / PVME blends at composition 70/30 wt%



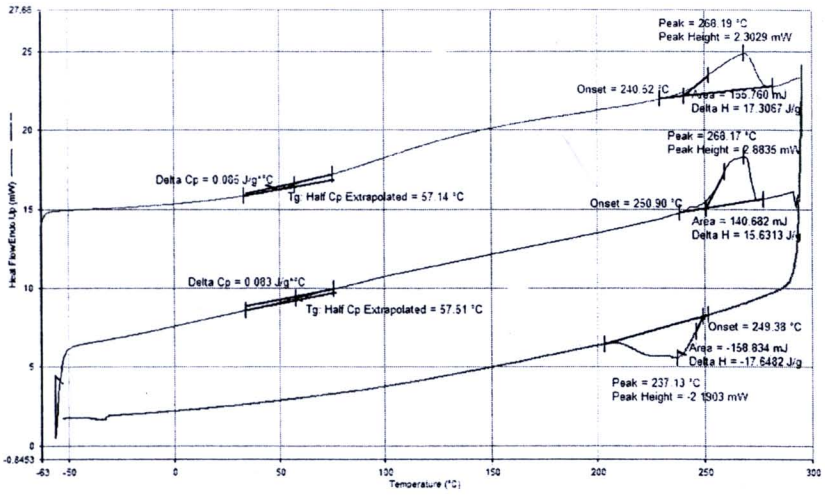
รูปที่ A.94 DSC curve of sPS1 / PVME blends at composition 80/20 wt%



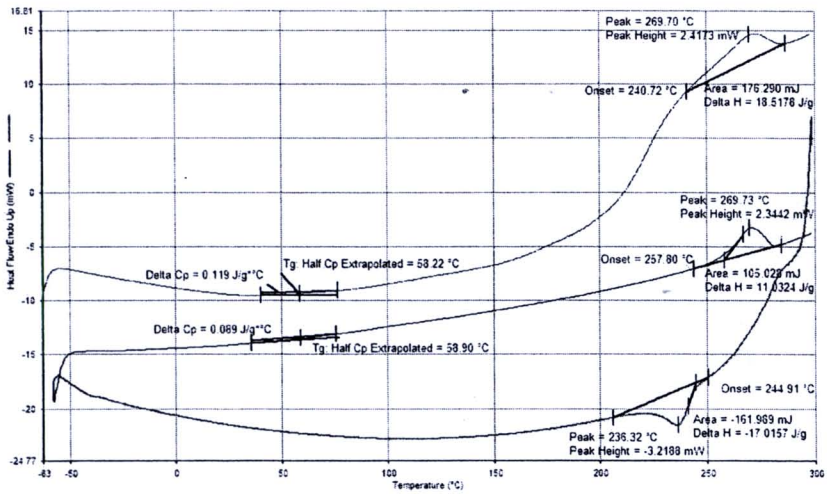
รูปที่ A.95 DSC curve of sPS2 / PVME blends at composition 80/20 wt%



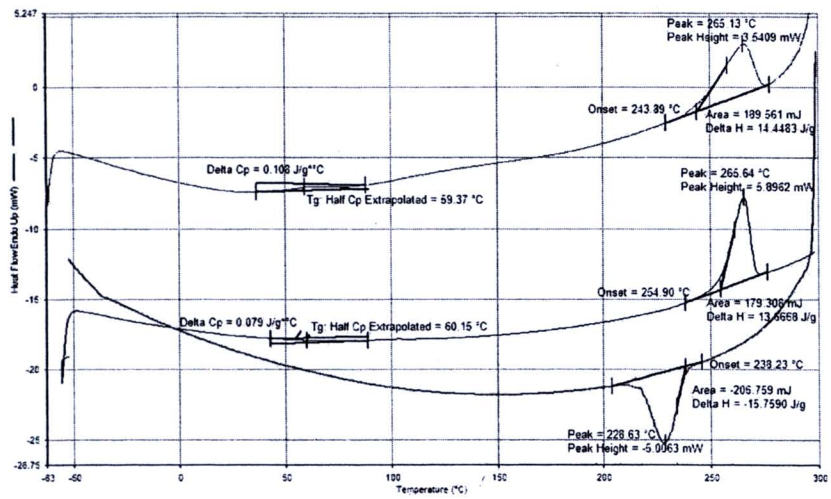
รูปที่ A.96 DSC curve of sPS3 / Polyisoprene blends at composition 80/20 wt%



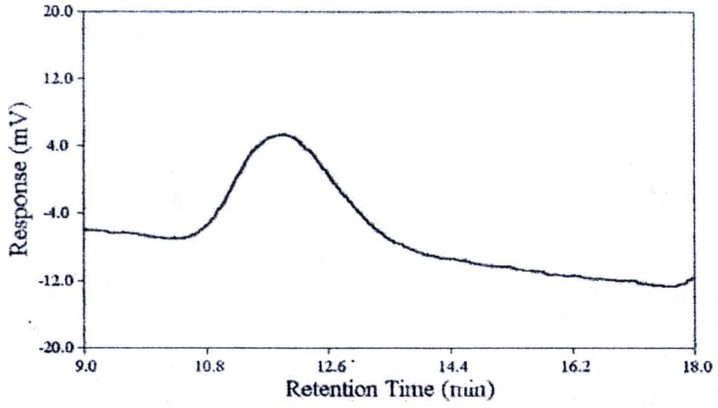
รูปที่ A.97 DSC curve of sPS1 / PVME blends at composition 90/10 wt%



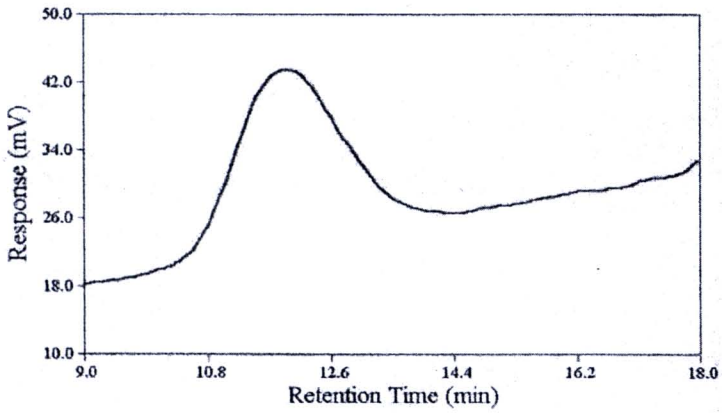
รูปที่ A.98 DSC curve of sPS2 / PVME blends at composition 90/10 wt%



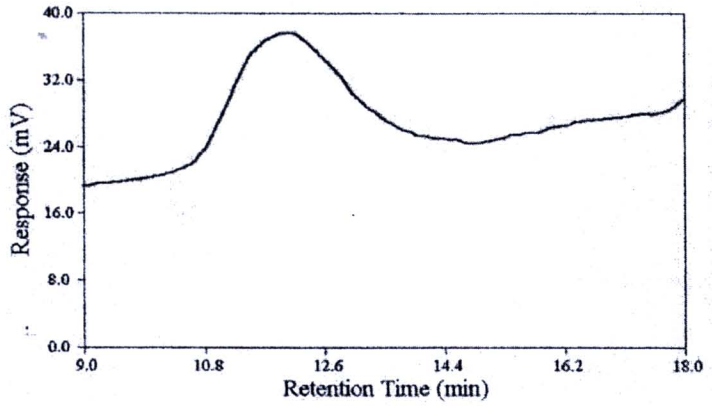
รูปที่ A.99 DSC curve of sPS3 / PVME blends at composition 90/10 wt%



รูปที่ A.100 The chromatogram of sPS1



รูปที่ A.101 The chromatogram of sPS2



รูปที่ A.102 The chromatogram of sPS3

ข้อมูลการทดลองโดยละเอียดตอนที่สอง

The Data of DSC Characterization

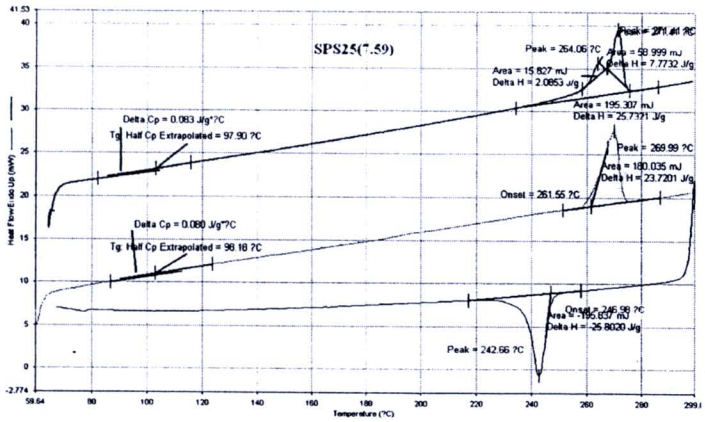


Figure B.1 DSC curve of SPS

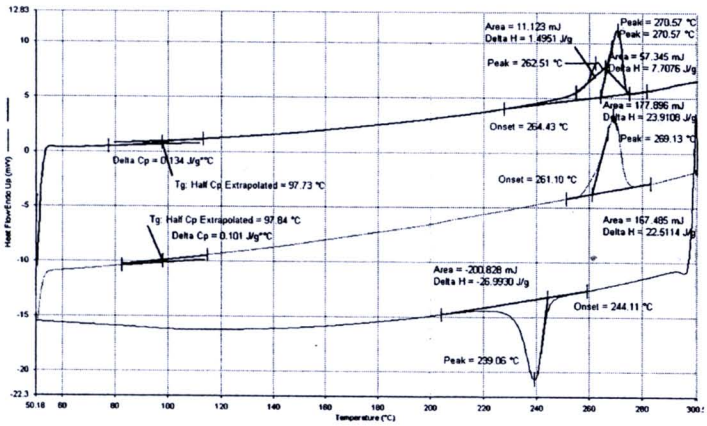


Figure B.2 DSC curve of SPS blended with LCC

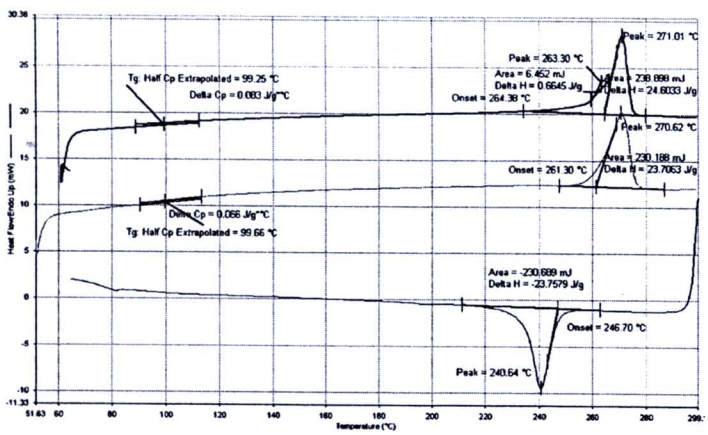


Figure B.3 DSC curve of SPS blended with GMS

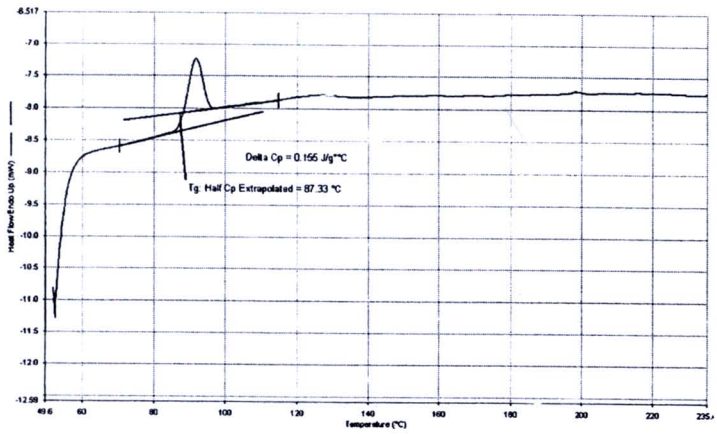


Figure B.4 DSC curve of PaMS

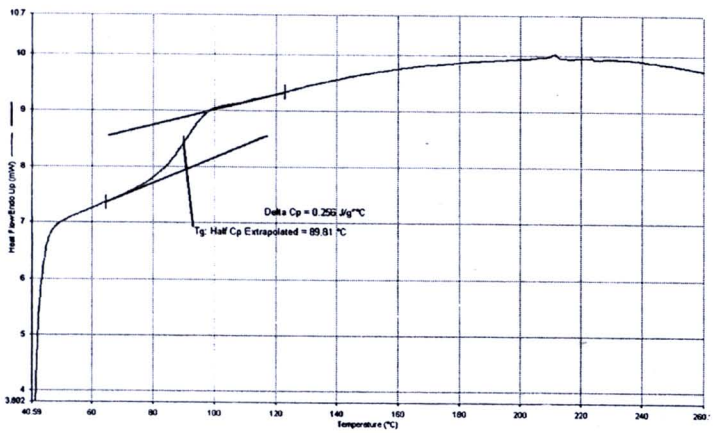


Figure B.5 DSC curve of PaMS blended with LCC

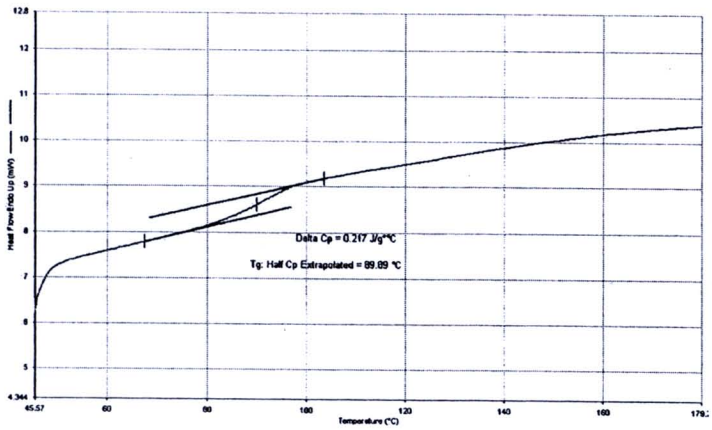


Figure B.6 DSC curve of PaMS blended with GMS

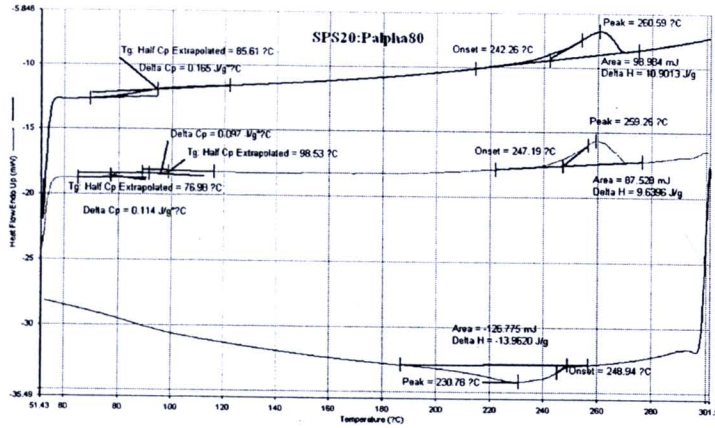


Figure B.7 DSC curve of SPS20/PaMS80 blends

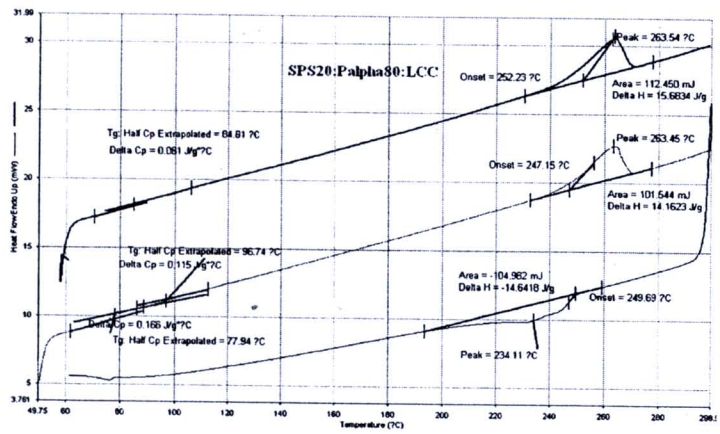


Figure B.8 DSC curve of SPS20/PaMS80/LCC blends

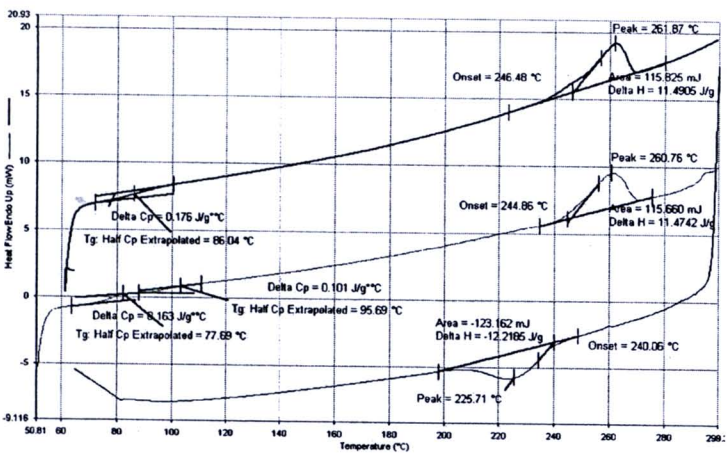


Figure B.9 DSC curve of SPS20/PaMS80/GMS blends

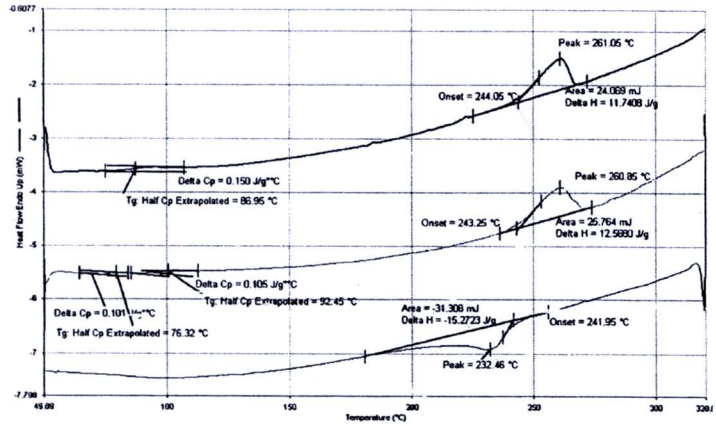


Figure B.10 DSC curve of SPS40/PaMS60 blends

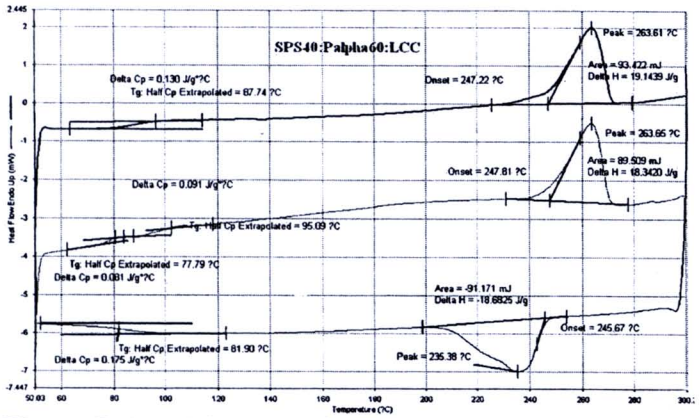


Figure B.11 DSC curve of SPS40/PaMS60/LCC blends

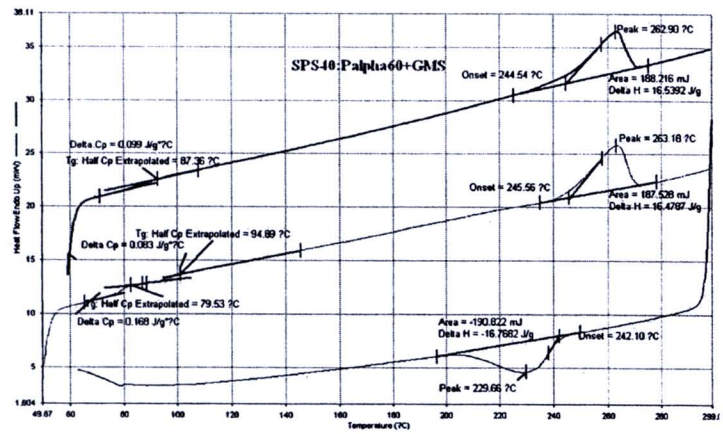


Figure B.12 DSC curve of SPS40/PaMS60/GMS blends

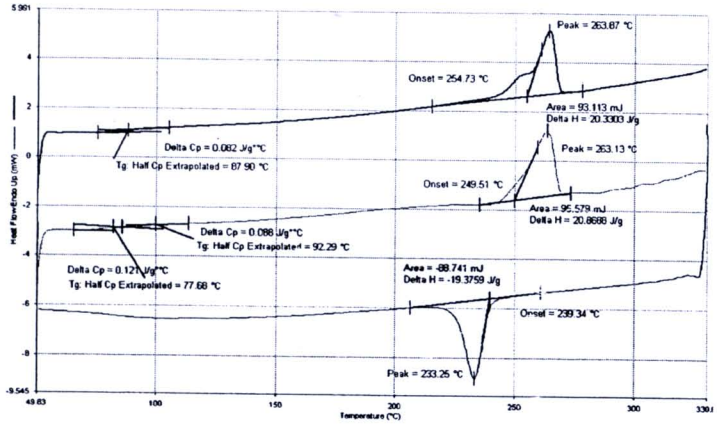


Figure B.13 DSC curve of SPS60/PaMS40 blends

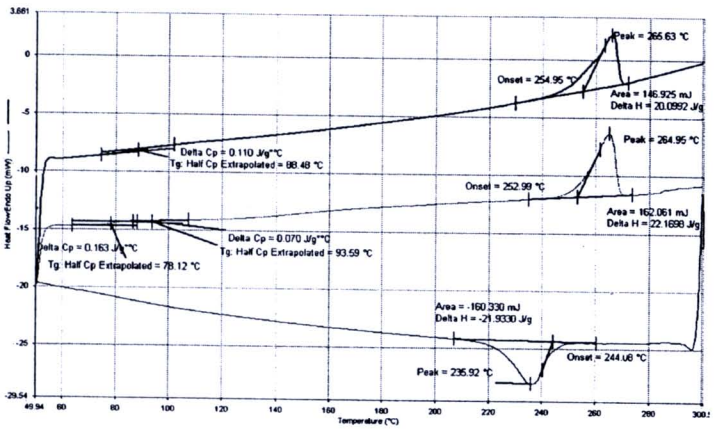


Figure B.14 DSC curve of SPS60/PaMS40/LCC blends

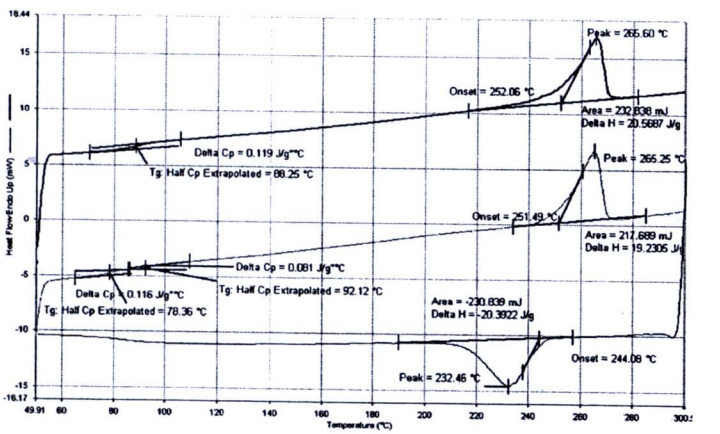


Figure B.15 DSC curve of SPS60/PaMS40/GMS blends

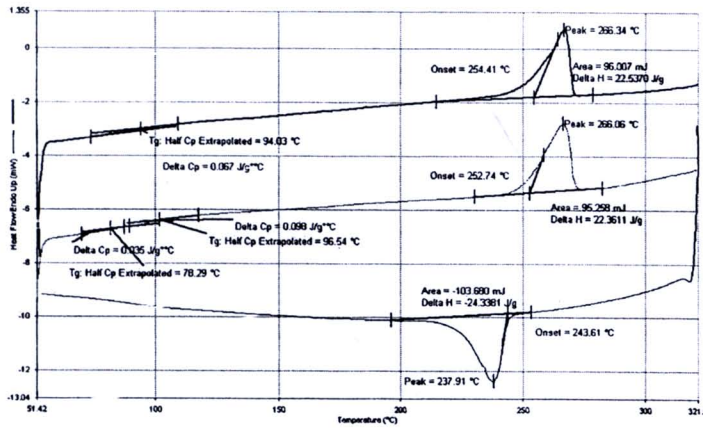


Figure B.16 DSC curve of SPS80/PaMS20 blends

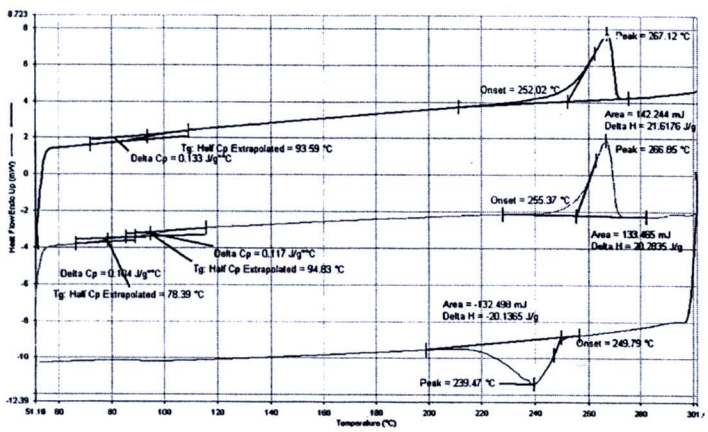


Figure B.17 DSC curve of SPS80/PaMS20/LCC blends

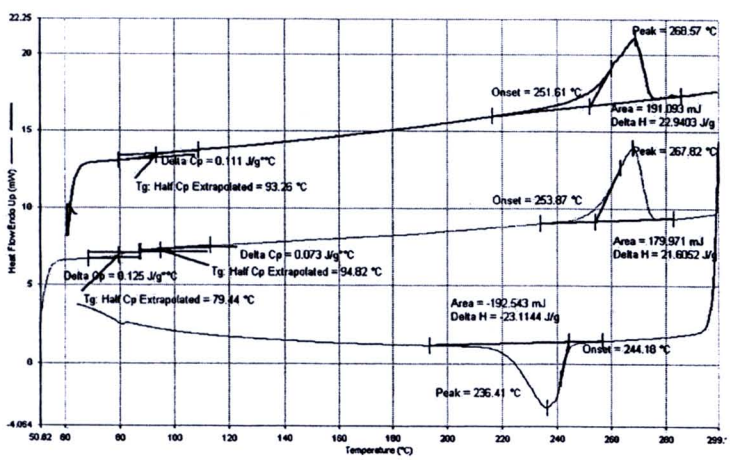


Figure B.18 DSC curve of SPS80/PaMS20/GMS blends

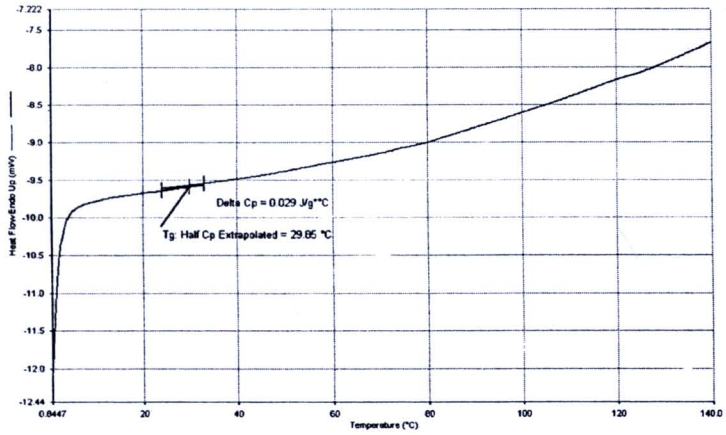


Figure B.19 DSC curve of PBMA

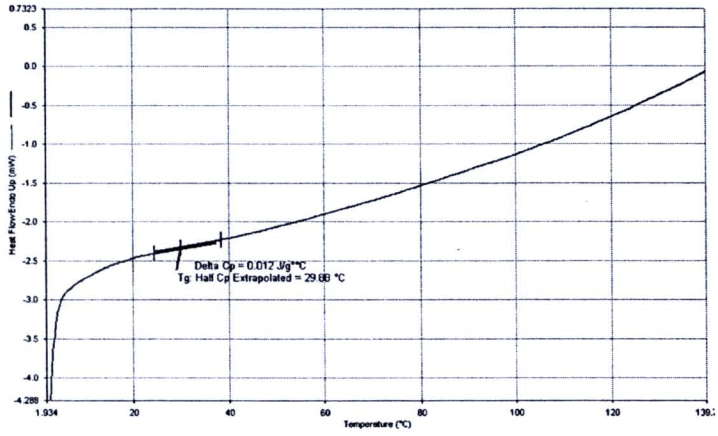


Figure B.20 DSC curve of PBMA blended with LCC

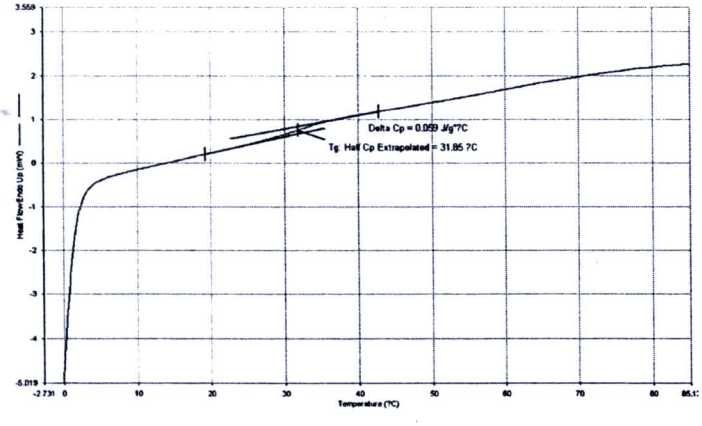


Figure B.21 DSC curve of PBMA blended with GMS

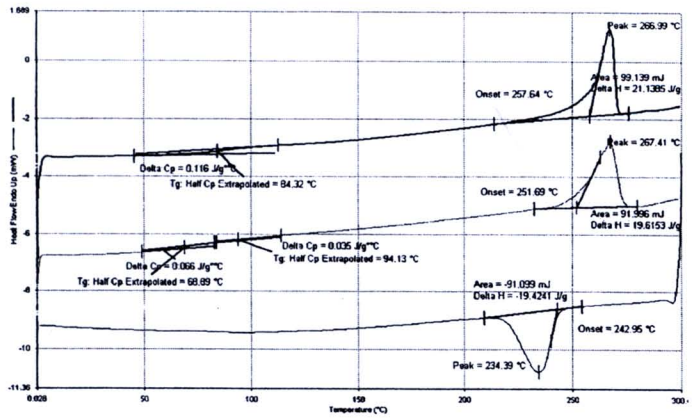


Figure B.22 DSC curve of SPS20/PBMA80 blends

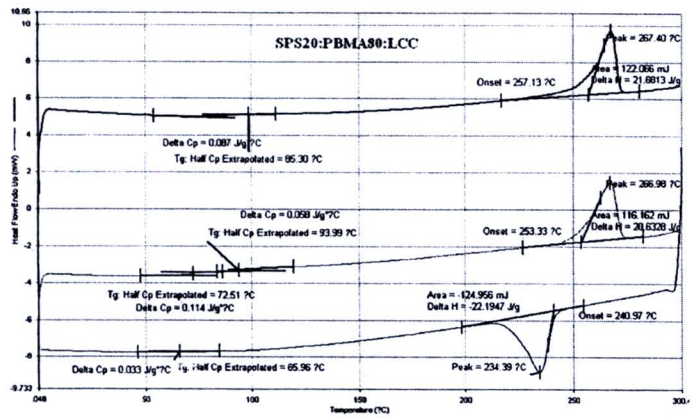


Figure B.23 DSC curve of SPS20/PBMA80/LCC blends

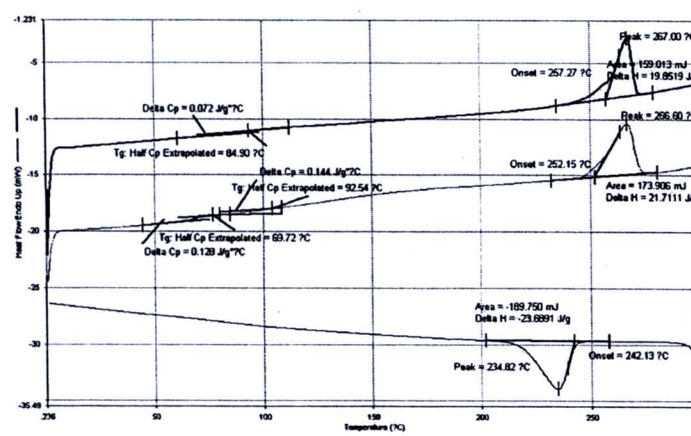


Figure B.24 DSC curve of SPS20/PBMA80/GMS blends

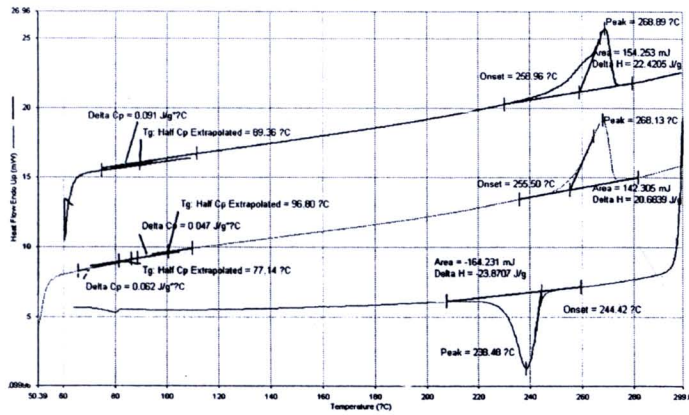


Figure B.25 DSC curve of SPS40/PBMA60 blends

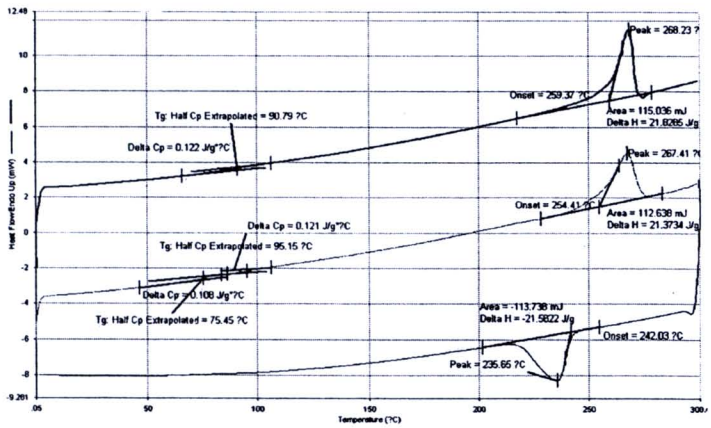


Figure B.26 DSC curve of SPS40/PBMA60/LCC blends

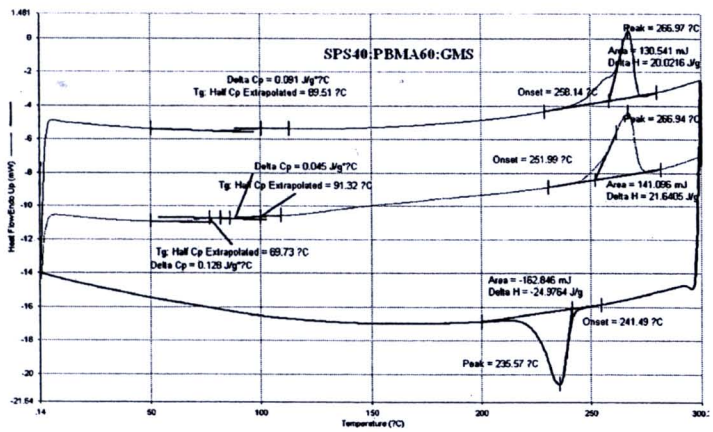


Figure B.27 DSC curve of SPS40/PBMA60/GMS blends

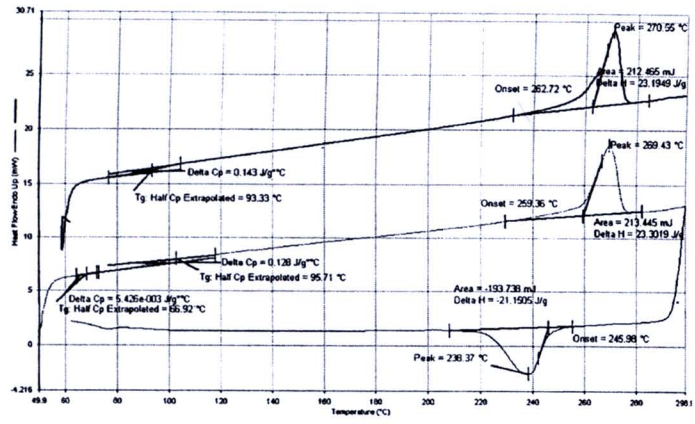


Figure B.28 DSC curve of SPS60/PBMA40 blends

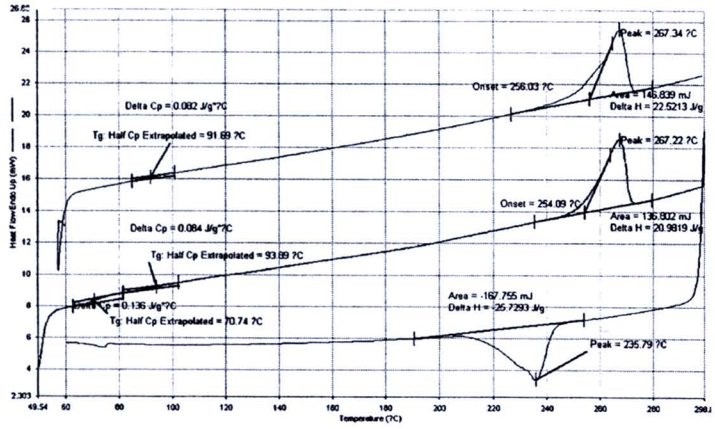


Figure B.29 DSC curve of SPS60/PBMA40/LCC blends

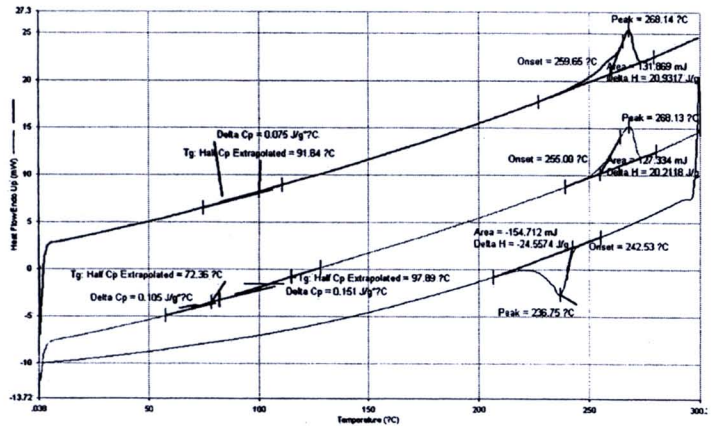


Figure B.30 DSC curve of SPS60/PBMA40/GMS blends

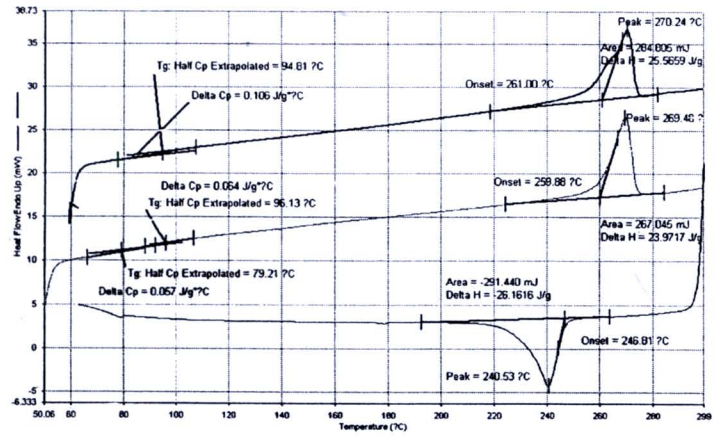


Figure B.31 DSC curve of SPS80/PBMA20 blends

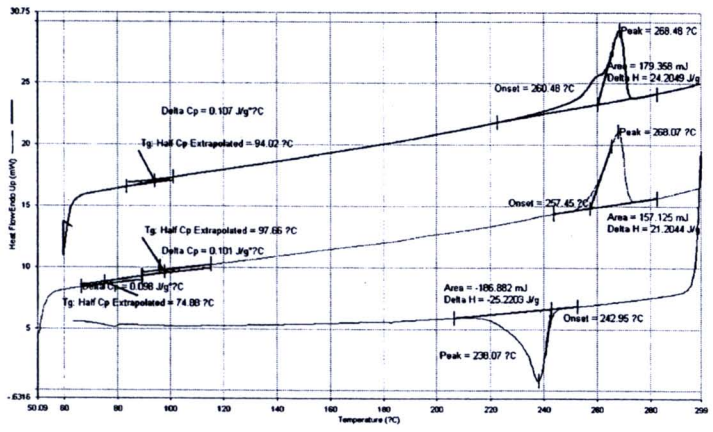


Figure B.32 DSC curve of SPS80/PBMA20/LCC blends

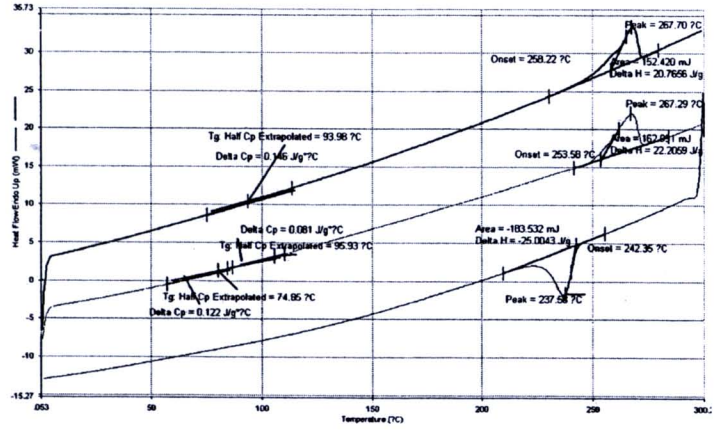


Figure B.33 DSC curve of SPS80/PBMA20/GMS blends

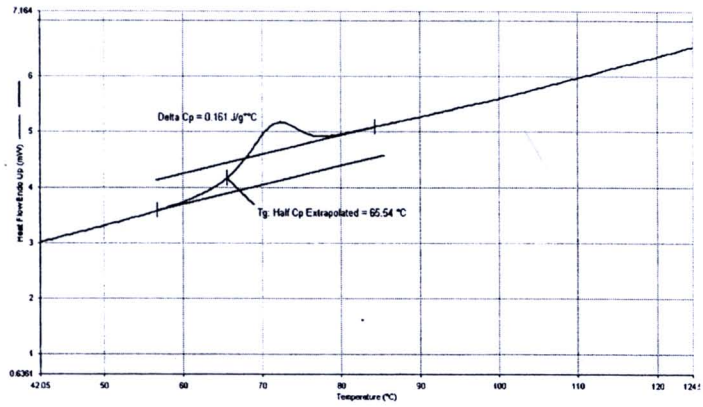


Figure B.34 DSC curve of PEMA

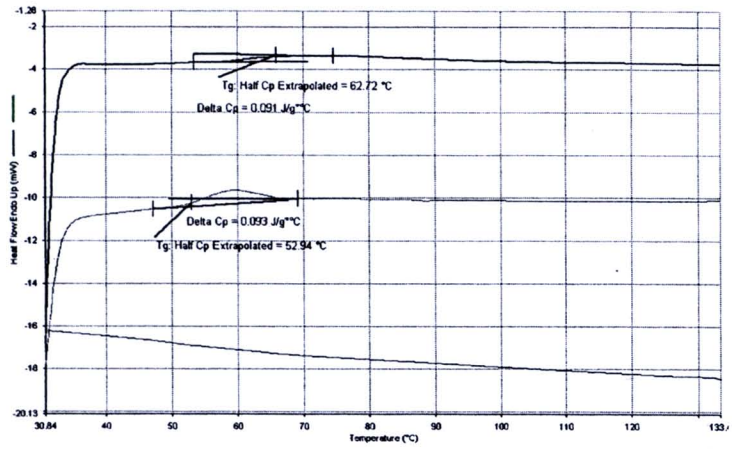


Figure B.35 DSC curve of PEMA blended with LCC

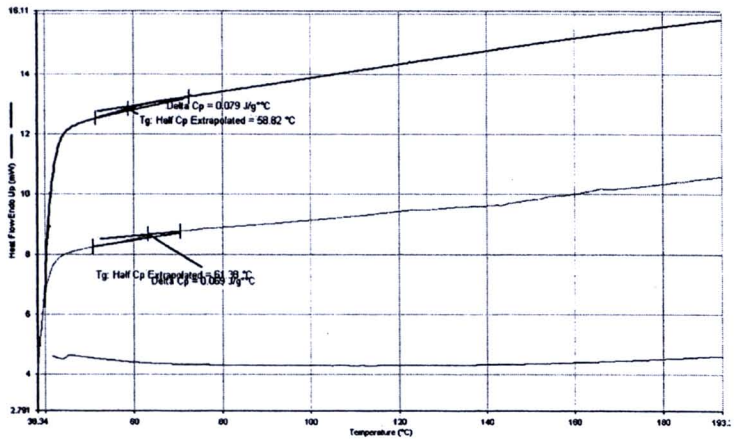


Figure B.36 DSC curve of PEMA blended with GMS

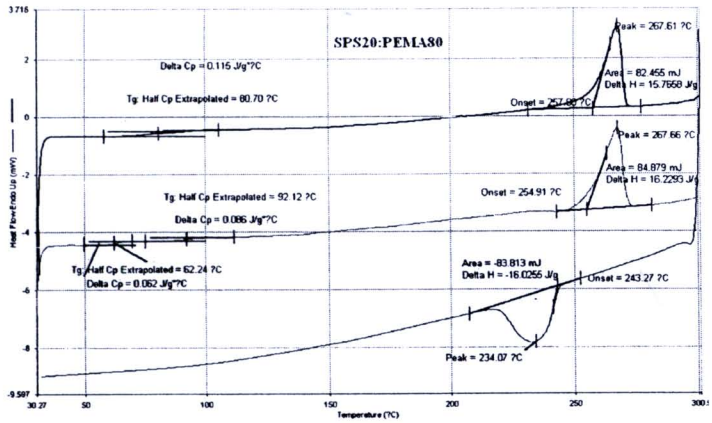


Figure B.37 DSC curve of SPS20/PEMA80 blends

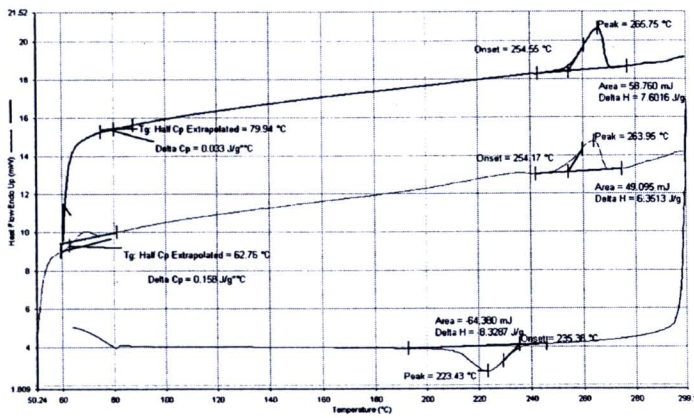


Figure B.38 DSC curve of SPS20/PEMA80/LCC blends

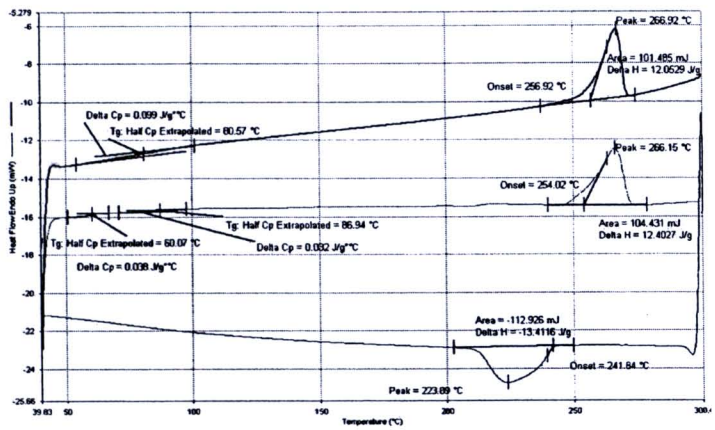


Figure B.39 DSC curve of SPS20/PEMA80/GMS blends

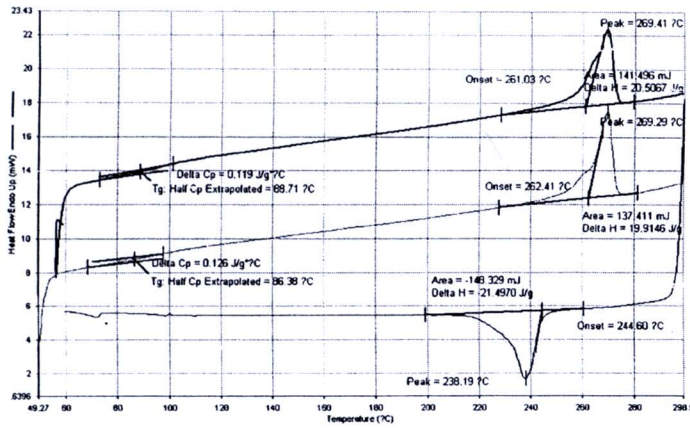


Figure B.40 DSC curve of SPS40/PEMA60 blends

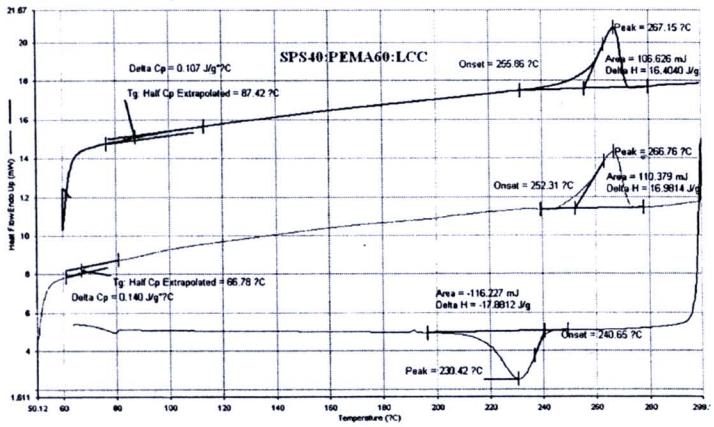


Figure B.41 DSC curve of SPS40/PEMA60/LCC blends

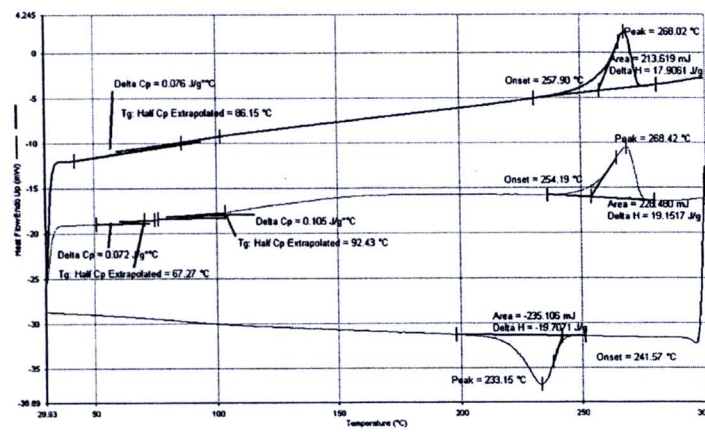


Figure B.42 DSC curve of SPS40/PEMA60/GMS blends

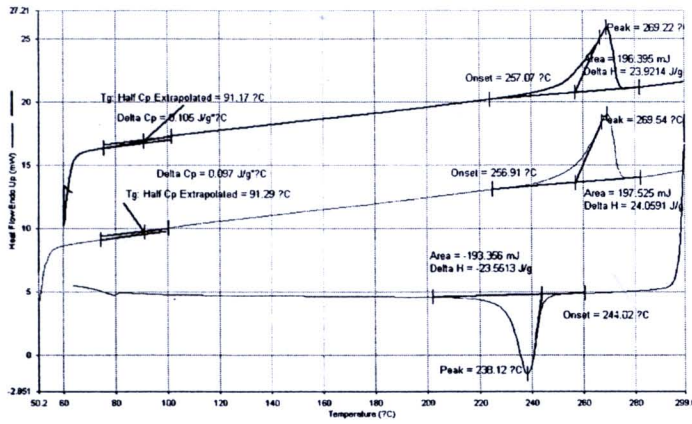


Figure B.43 DSC curve of SPS60/PEMA40 blends

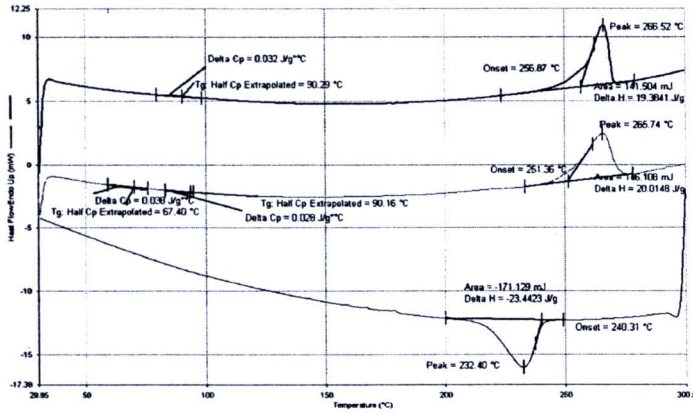


Figure B.44 DSC curve of SPS60/PEMA40/LCC blends

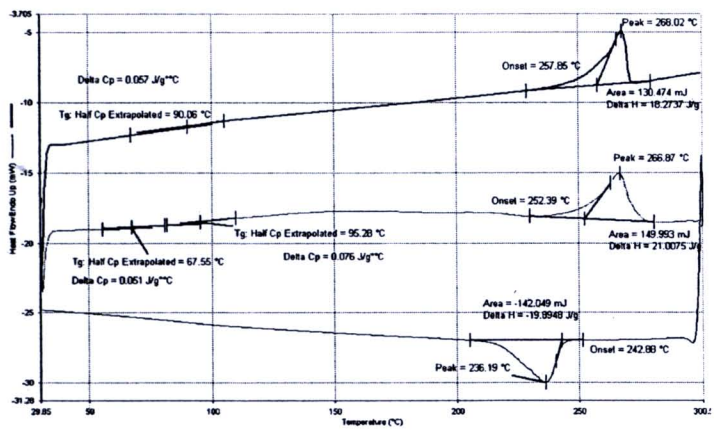


Figure B.45 DSC curve of SPS60/PEMA40/GMS blends

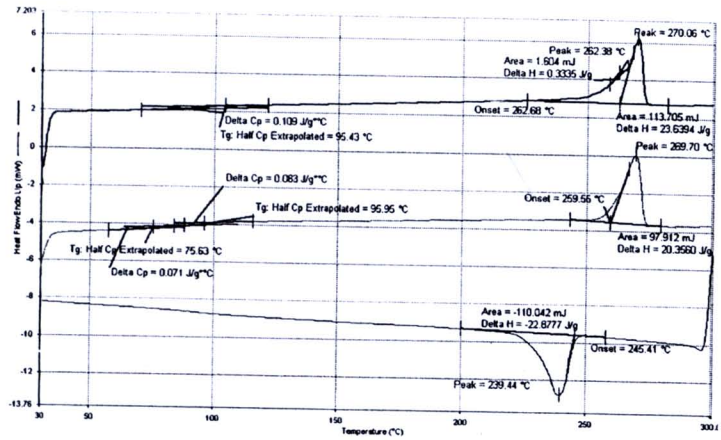


Figure B.46 DSC curve of SPS80/PEMA20 blends

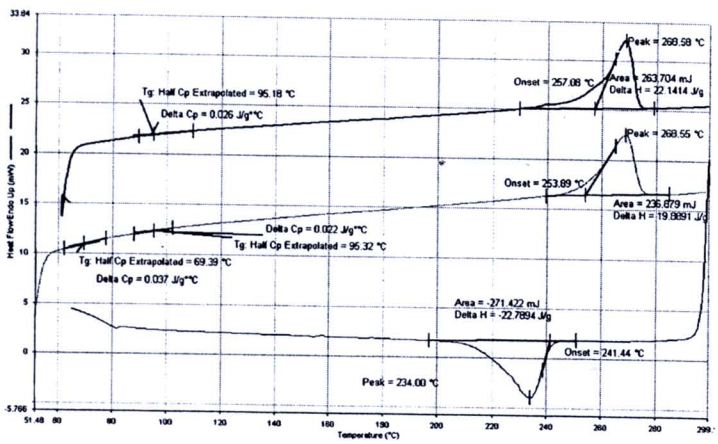


Figure B.47 DSC curve of SPS80/PEMA20/LCC blends

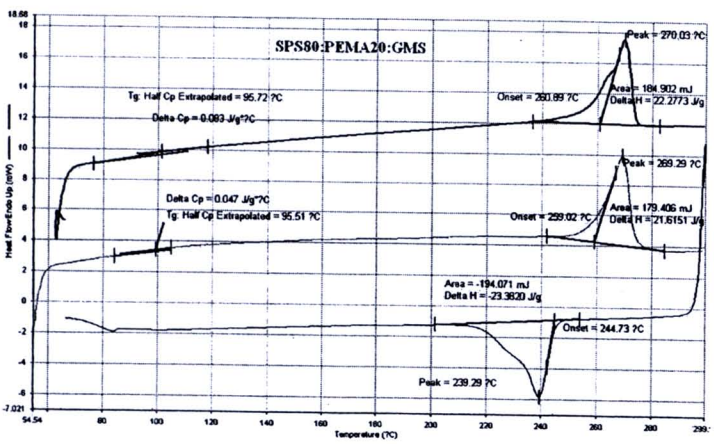


Figure B.48 DSC curve of SPS80/PEMA20/GMS blends

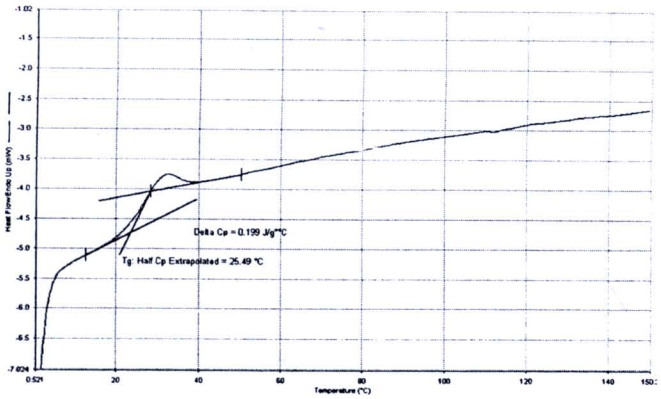


Figure B.49 DSC curve of PCHA

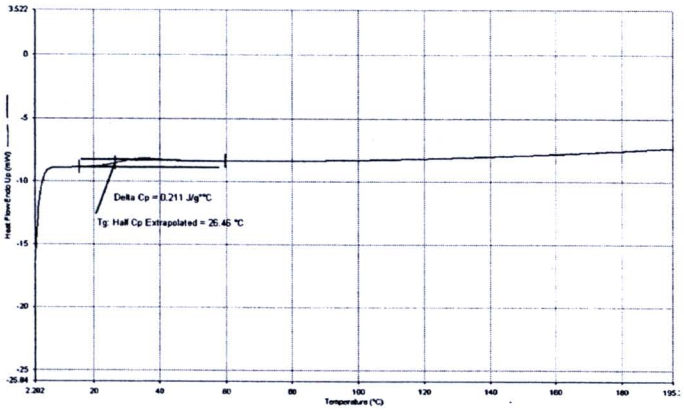


Figure B.50 DSC curve of PCHA blended with LCC

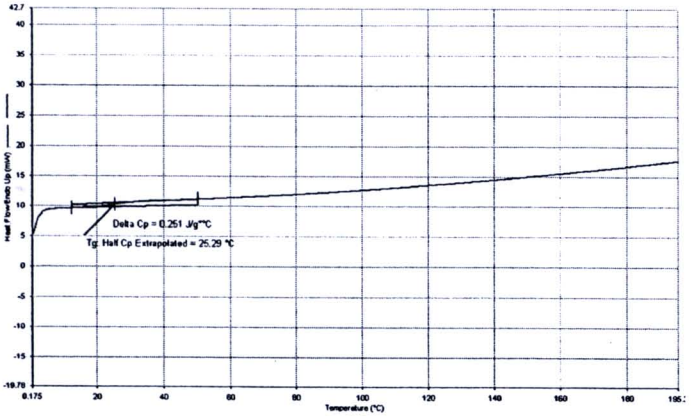


Figure B.51 DSC curve of PCHA blended with GMS

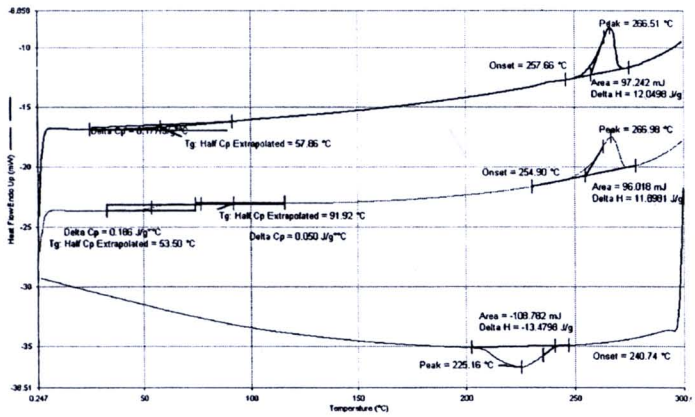


Figure B.52 DSC curve of SPS20/PCHA80 blends

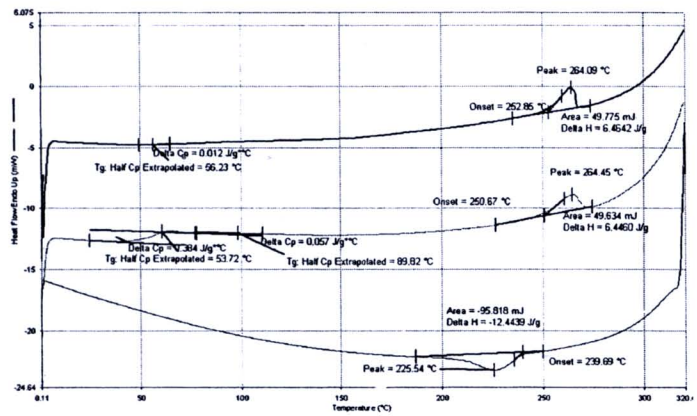


Figure B.53 DSC curve of SPS20/PCHA80/LCC blends

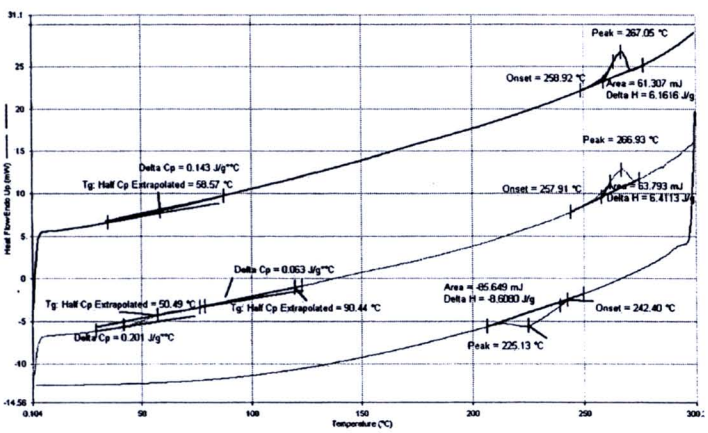


Figure B.54 DSC curve of SPS20/PCHA80/GMS blends

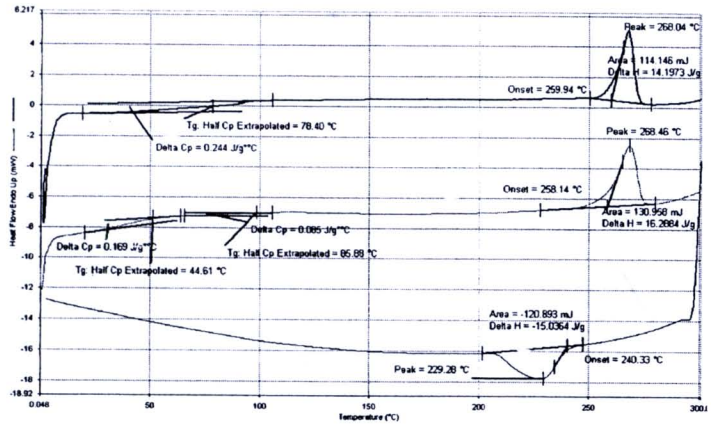


Figure B.55 DSC curve of SPS40/PCHA60 blends

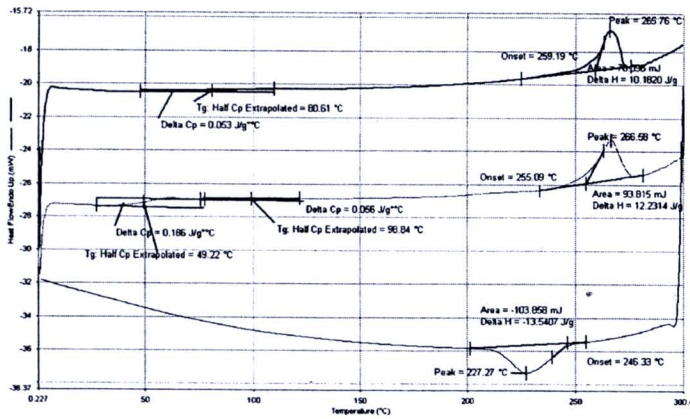


Figure B.56 DSC curve of SPS40/PCHA60/LCC blends

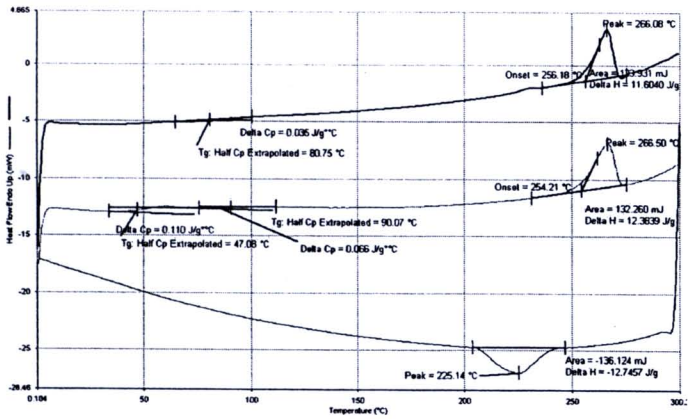


Figure B.57 DSC curve of SPS40/PCHA60/GMS blends

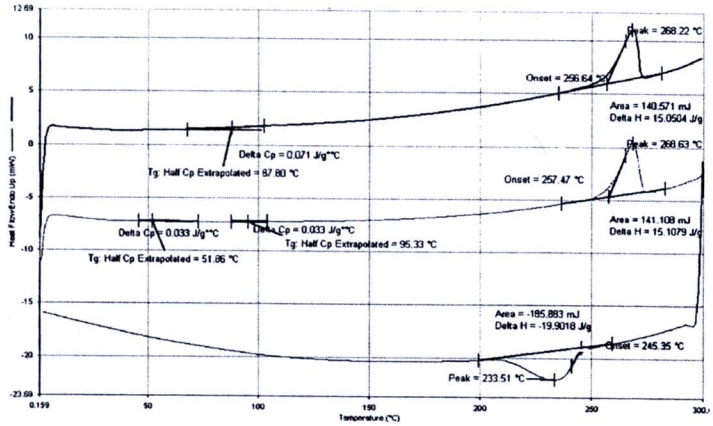


Figure B.58 DSC curve of SPS60/PCHA40 blends

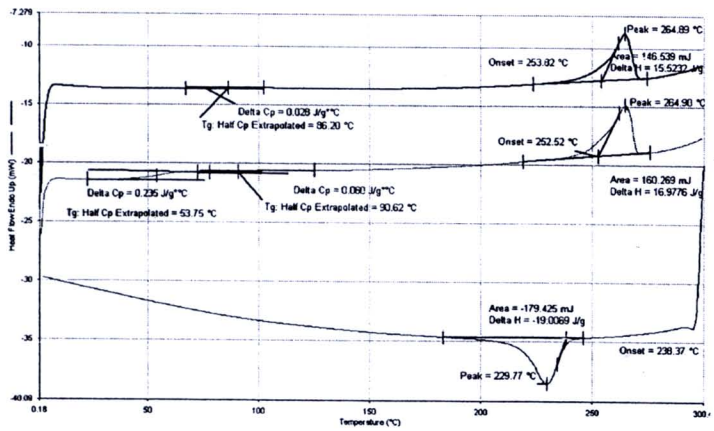


Figure B.59 DSC curve of SPS60/PCHA40/LCC blends

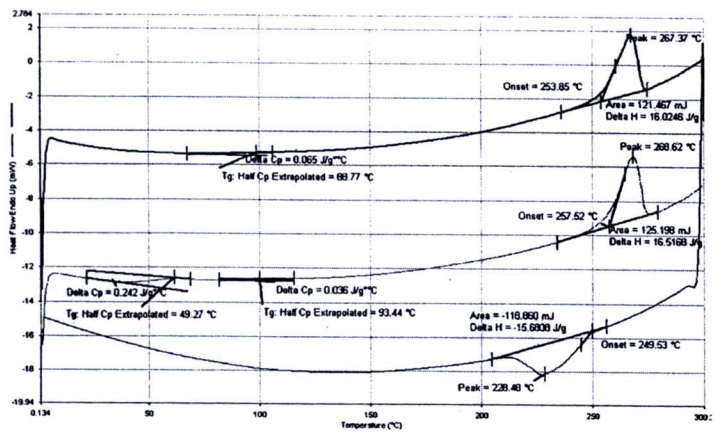


Figure B.60 DSC curve of SPS60/PCHA40/GMS blends

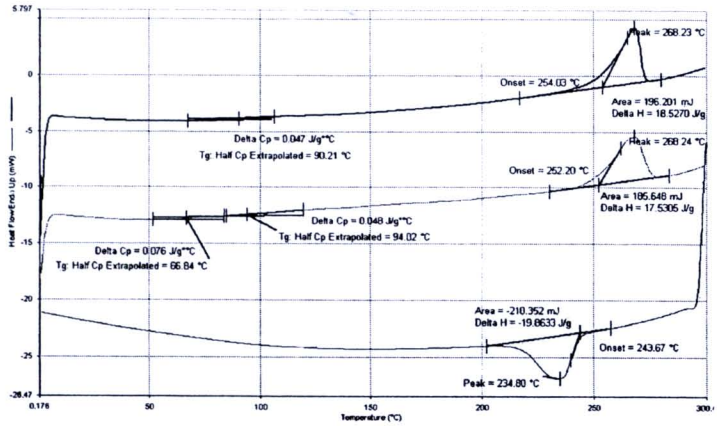


Figure B.61 DSC curve of SPS80/PCHA20 blends

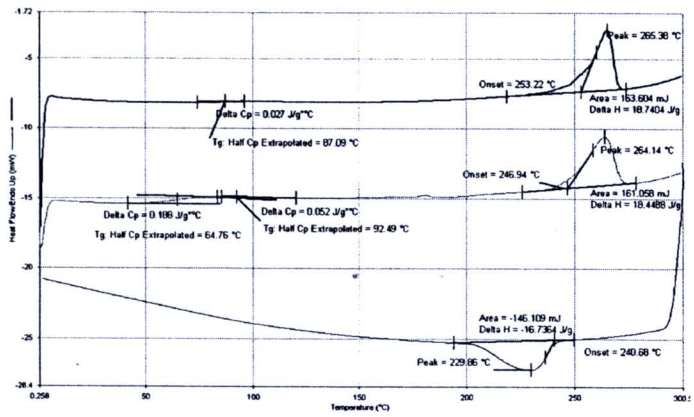


Figure B.62 DSC curve of SPS80/PCHA20/LCC blends

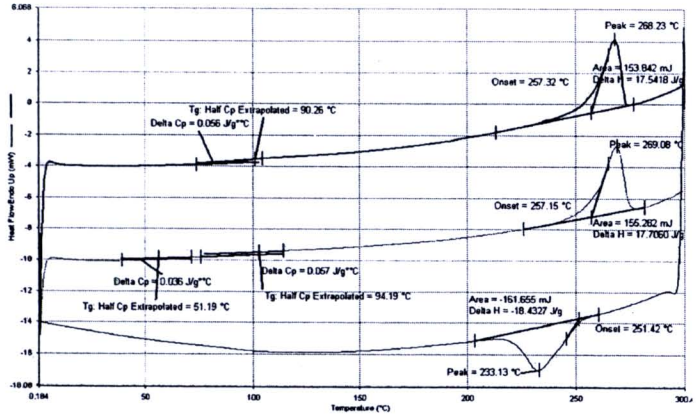


Figure B.63 DSC curve of SPS80/PCHA20/GMS blends

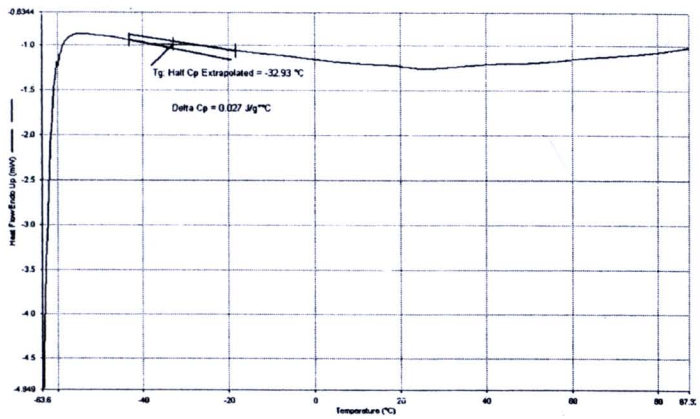


Figure B.64 DSC curve of PIP

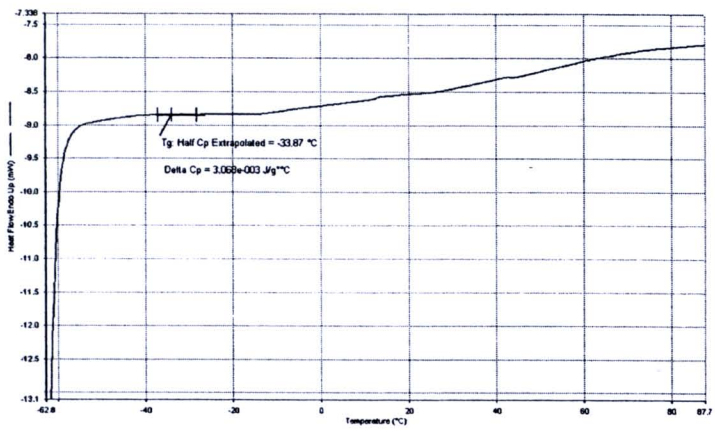


Figure B.65 DSC curve of PIP blended with LCC

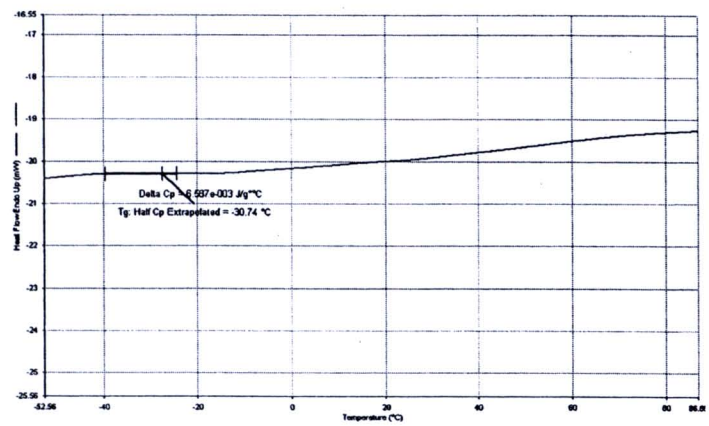


Figure B.66 DSC curve of PIP blended with GMS

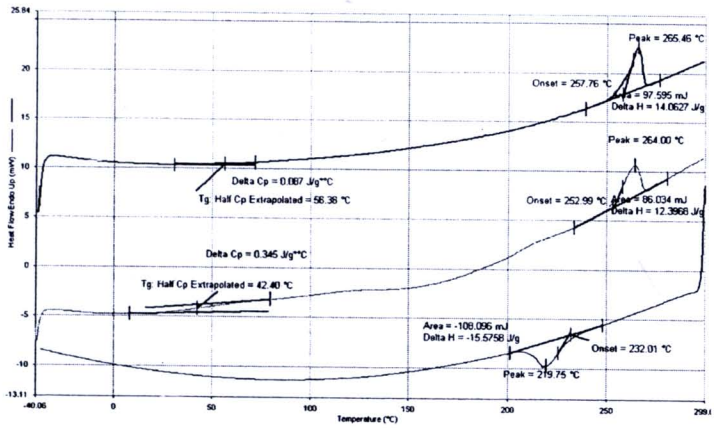


Figure B.67 DSC curve of SPS20/PIP80 blends

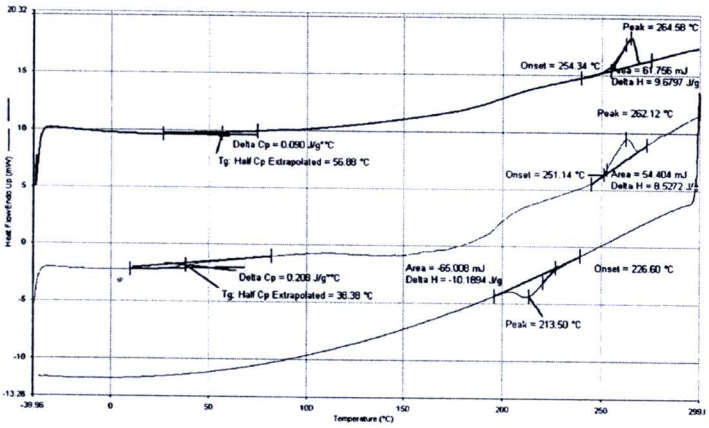


Figure B.68 DSC curve of SPS20/PIP80/LCC blends

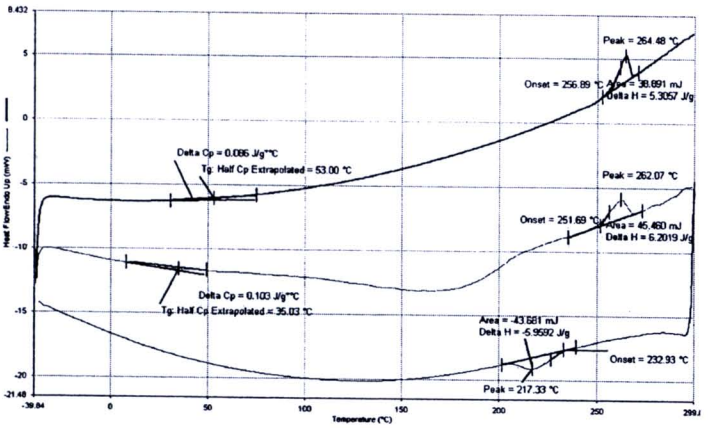


Figure B.69 DSC curve of SPS20/PIP80/GMS blends

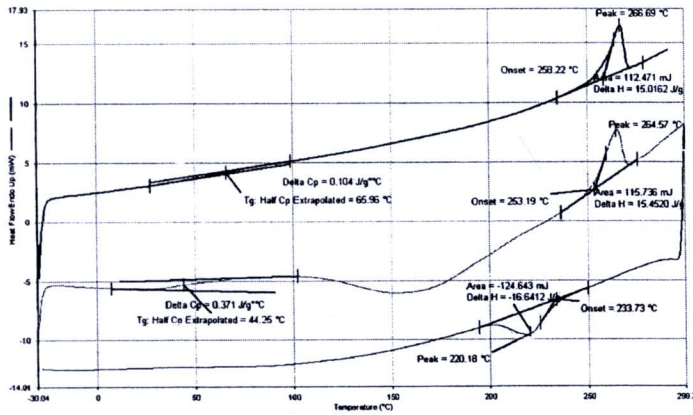


Figure B.70 DSC curve of SPS40/PIP60 blends

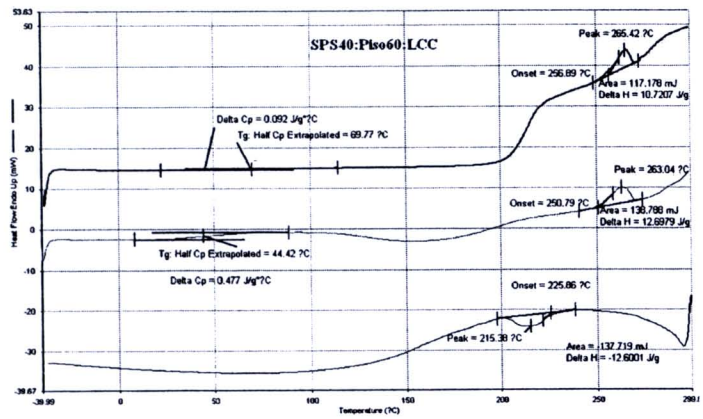


Figure B.71 DSC curve of SPS40/PIP60/LCC blends

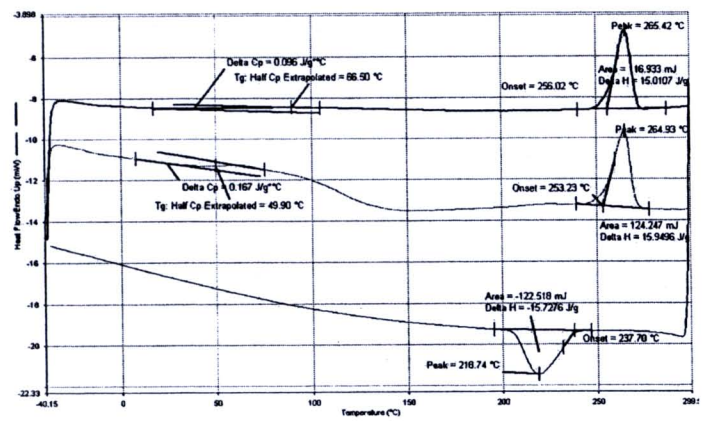


Figure B.72 DSC curve of SPS40/PIP60/GMS blends

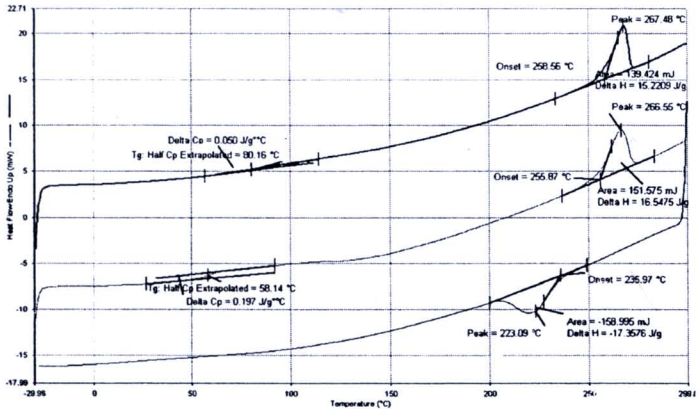


Figure B.73 DSC curve of SPS60/PIP40 blends

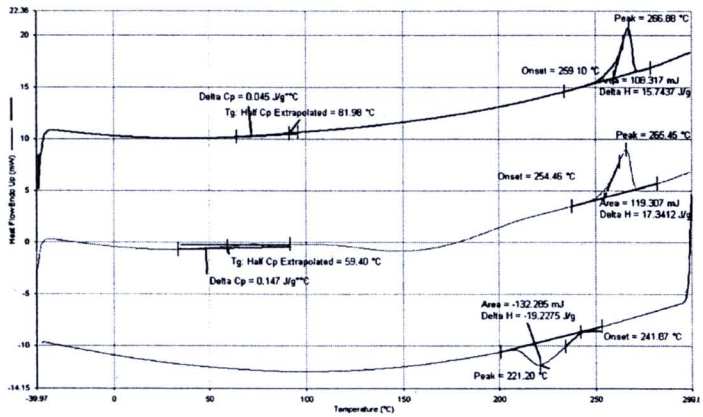


Figure B.74 DSC curve of SPS60/PIP40/LCC blends

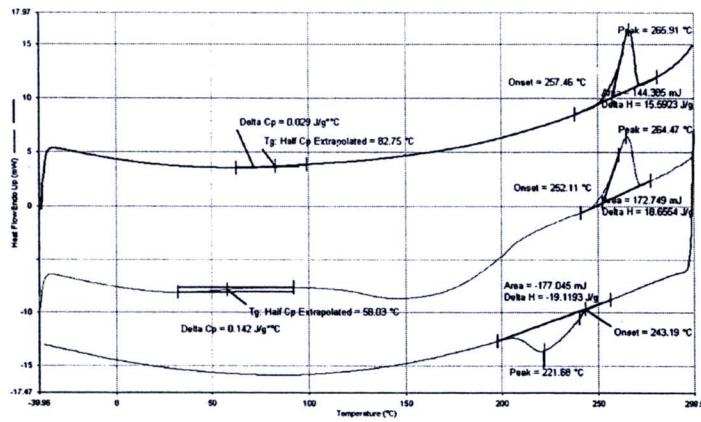


Figure B.75 DSC curve of SPS60/PIP40/GMS blends

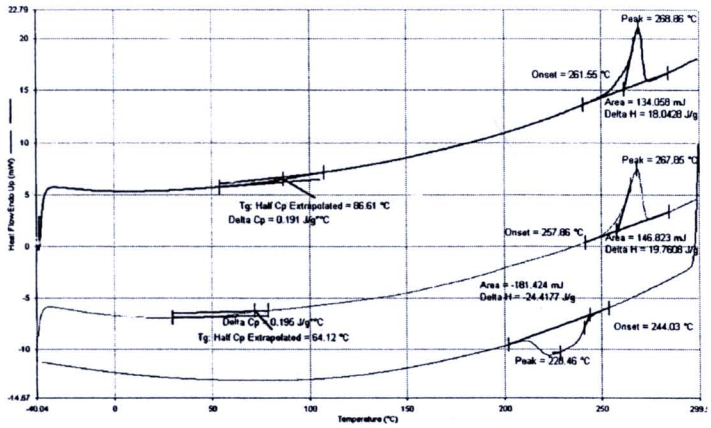


Figure B.76 DSC curve of SPS80/PIP20 blends

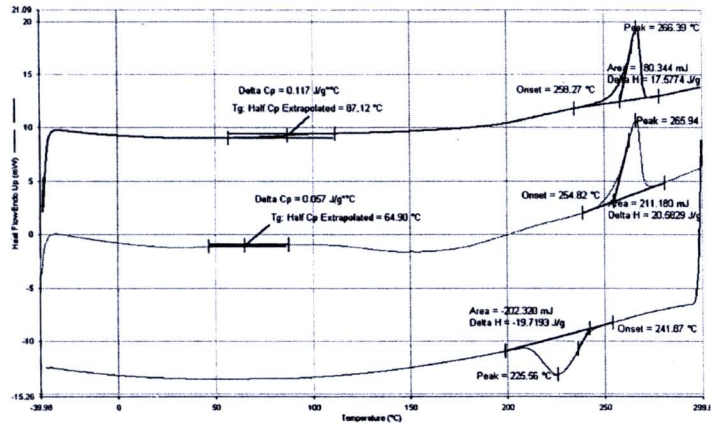


Figure B.77 DSC curve of SPS80/PIP20/LCC blends

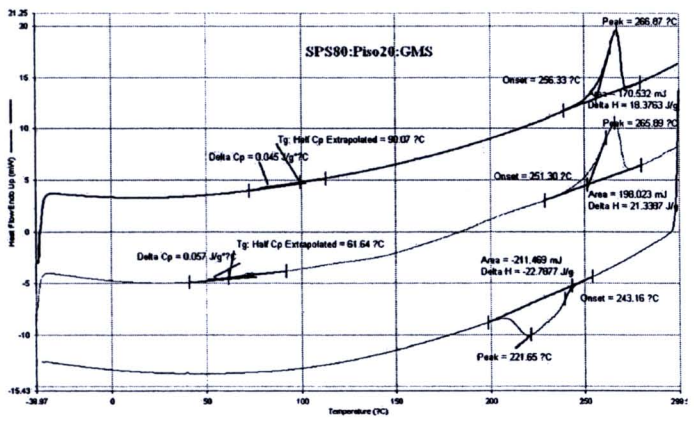


Figure B.78 DSC curve of SPS80/PIP20/GMS blends

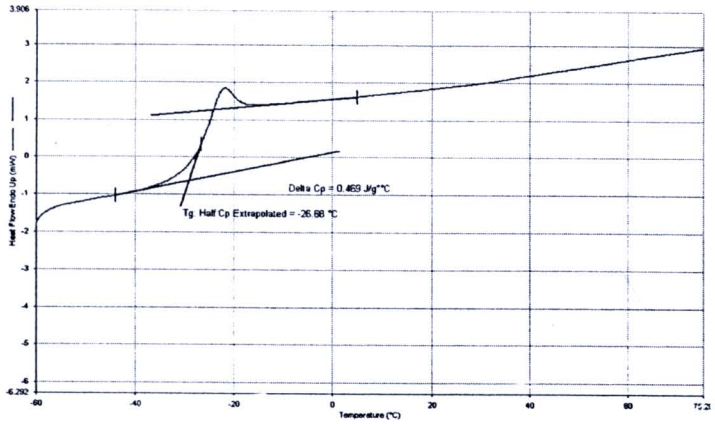


Figure B.79 DSC curve of PVME

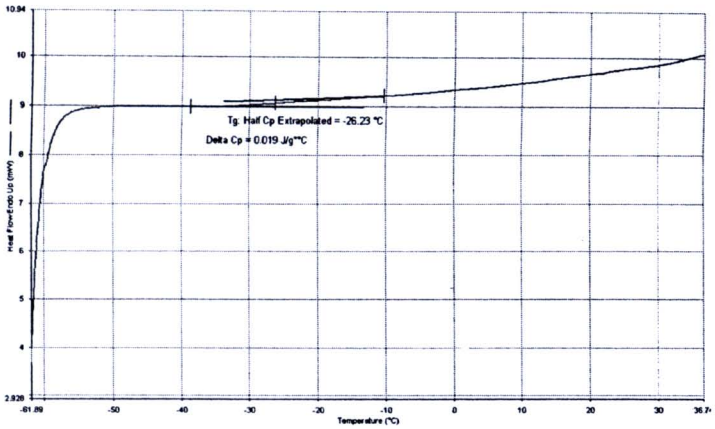


Figure B.80 DSC curve of PVME blended with LCC

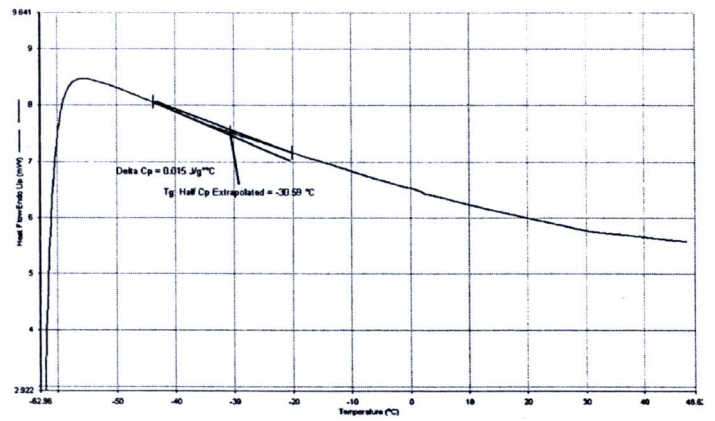


Figure B.81 DSC curve of PVME blended with GMS

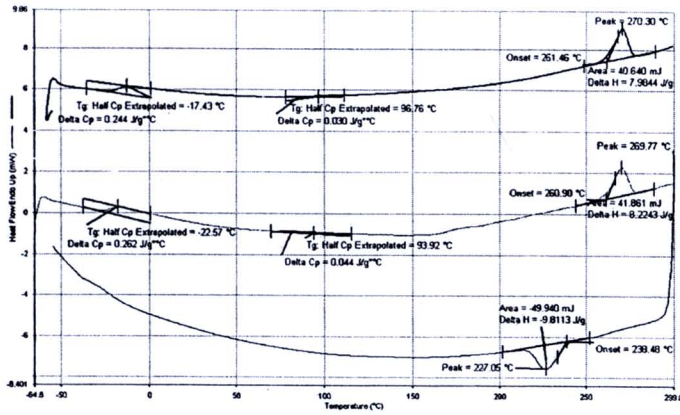


Figure B.82 DSC curve of SPS20/PVME80 blends

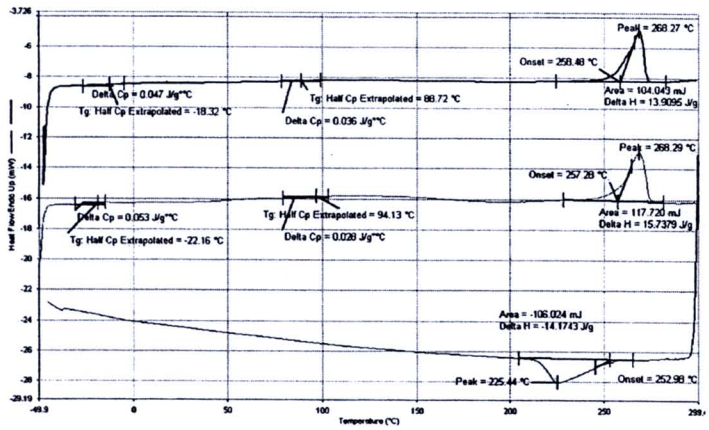


Figure B.83 DSC curve of SPS20/PVME80/LCC blends

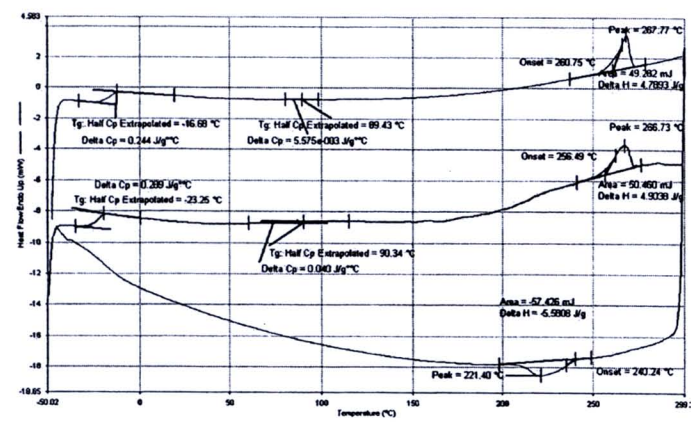


Figure B.84 DSC curve of SPS20/PVME80/GMS blends

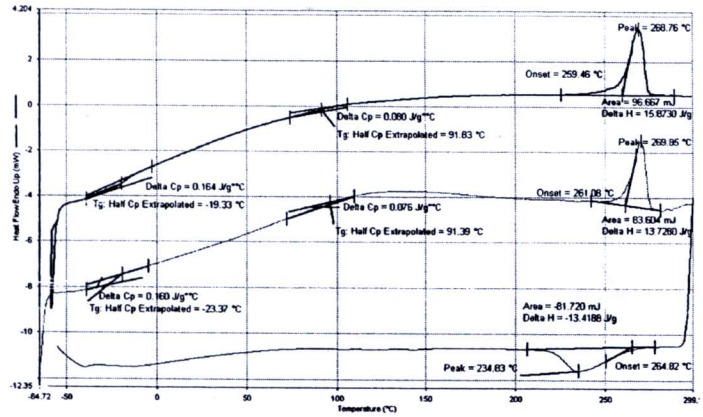


Figure B.85 DSC curve of SPS40/PVME60 blends

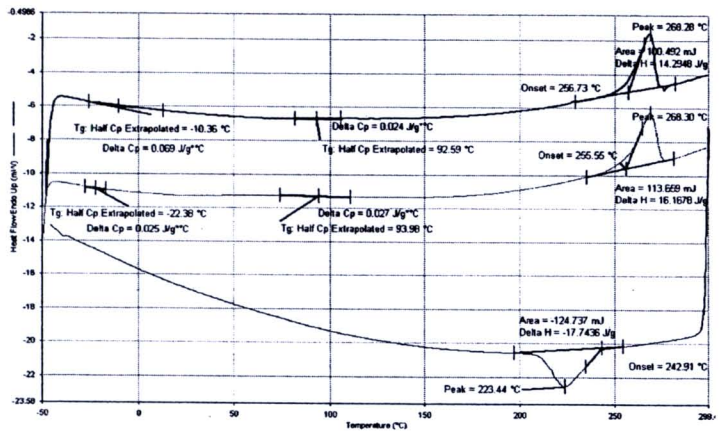


Figure B.86 DSC curve of SPS40/PVME60/LCC blends

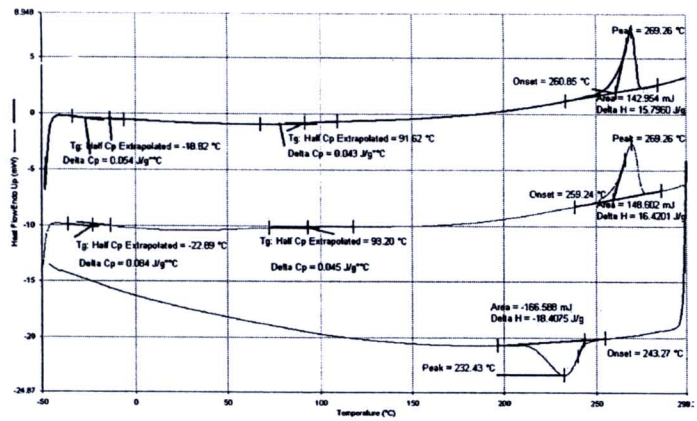


Figure B.87 DSC curve of SPS40/PVME60/GMS blends

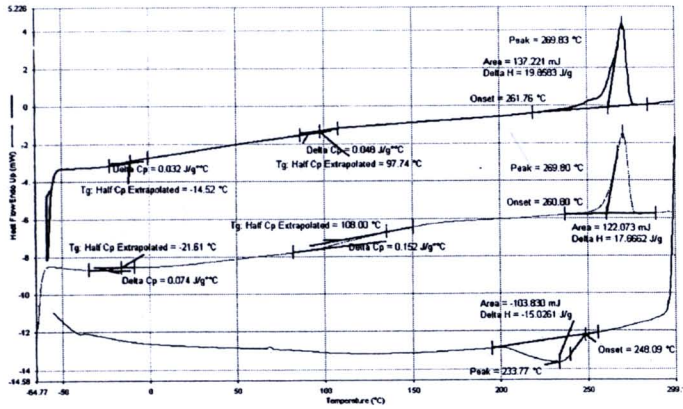


Figure B.88 DSC curve of SPS60/PVME40 blends

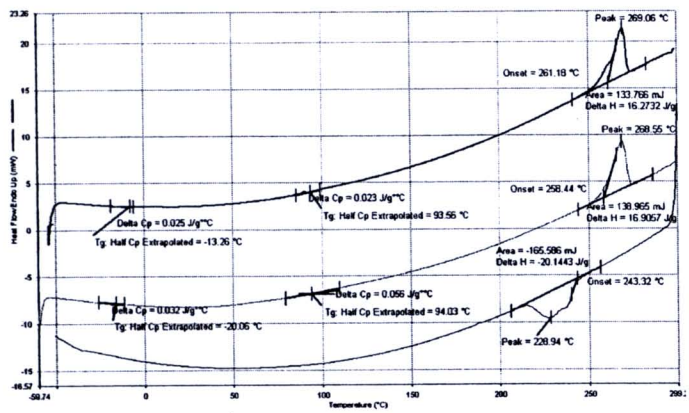


Figure B.89 DSC curve of SPS60/PVME40/LCC blends

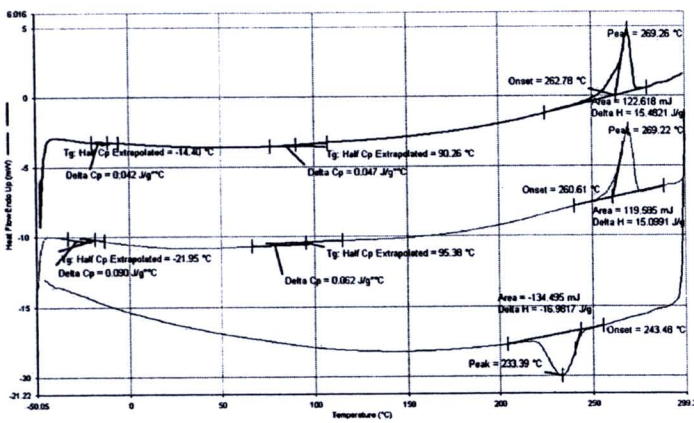


Figure B.90 DSC curve of SPS60/PVME40/GMS blends

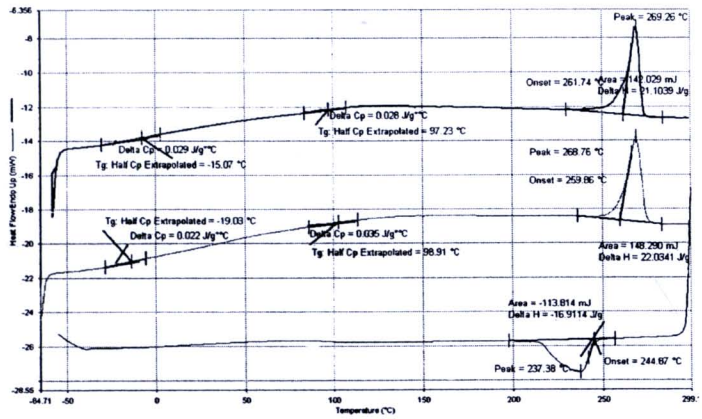


Figure B.91 DSC curve of SPS80/PVME20 blends

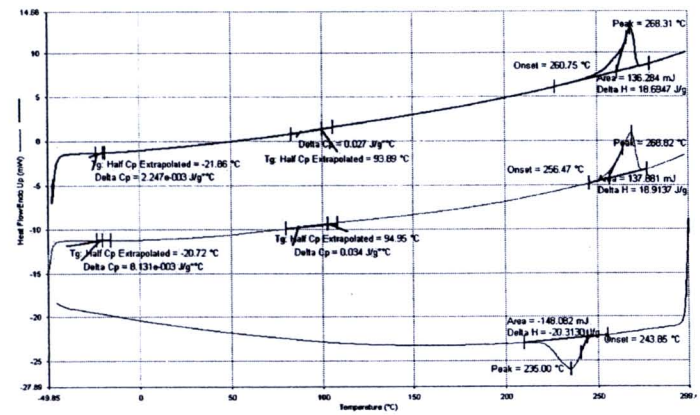


Figure B.92 DSC curve of SPS80/PVME20/LCC blends

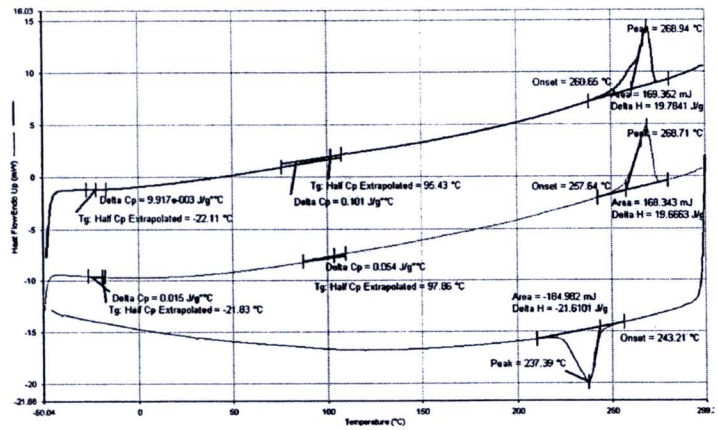
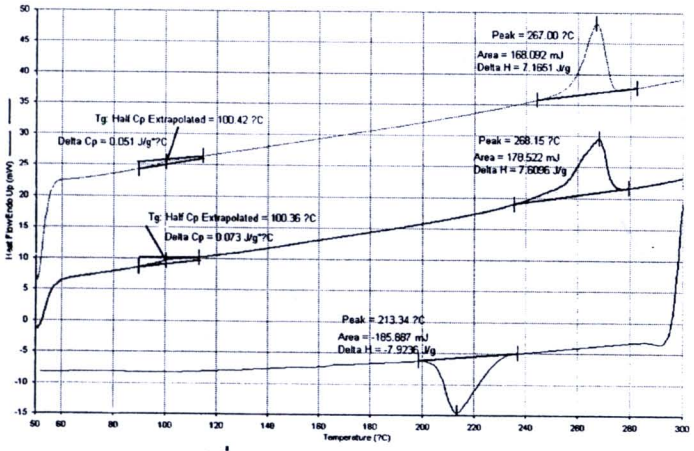


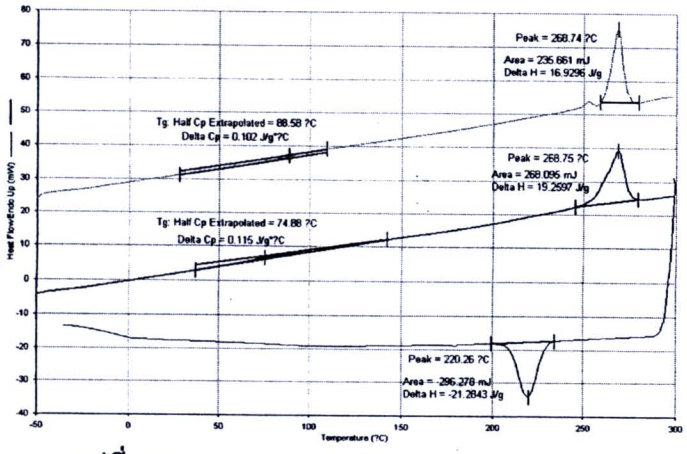
Figure B.93 DSC curve of SPS80/PVME20/GMS blends

ข้อมูลการทดลองโดยละเอียดตอนที่สาม

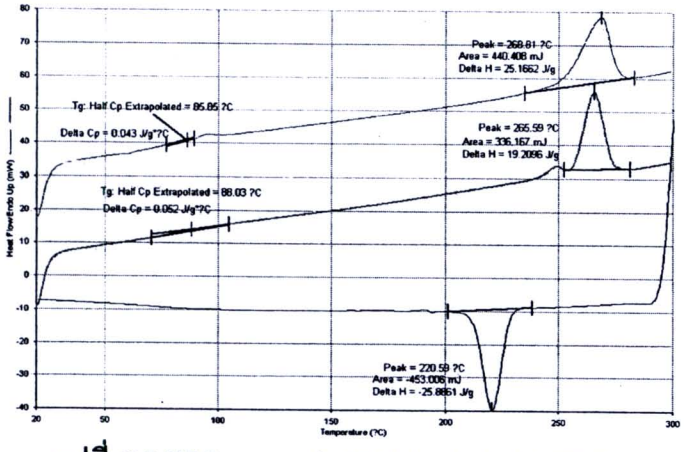
The Data of DSC Characterization



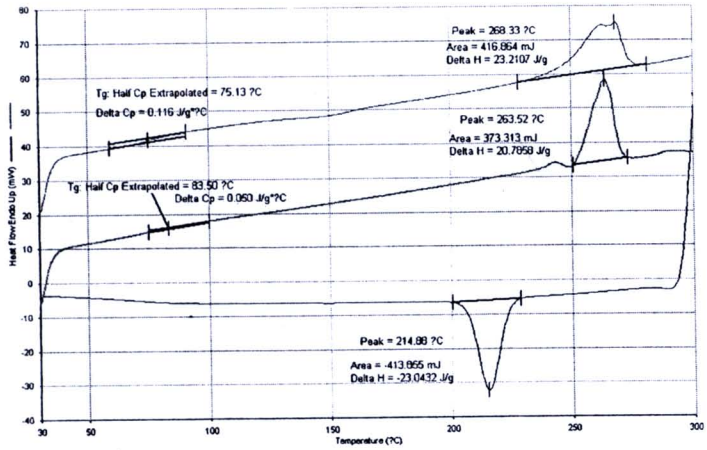
รูปที่ C.1 DSC curve of sPS1



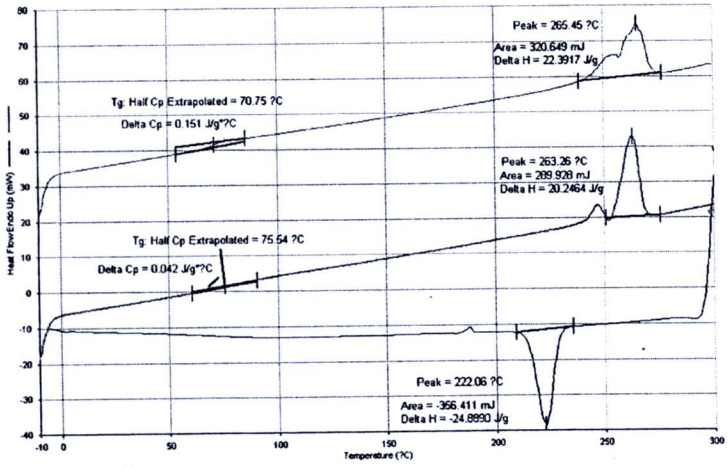
รูปที่ C.2 DSC curve of sPS1 blended with PIP



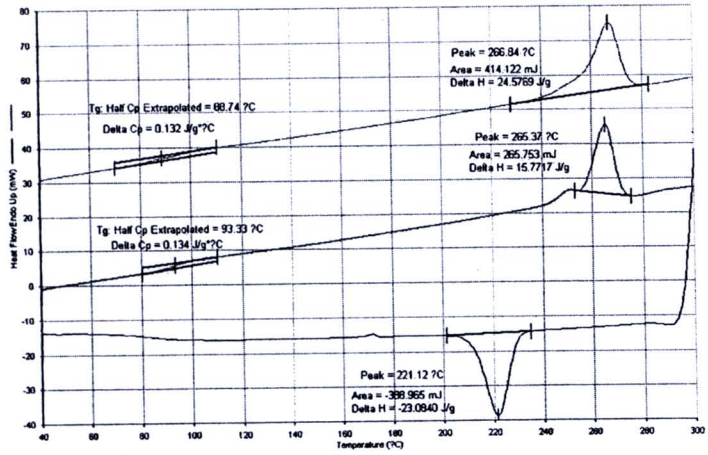
รูปที่ C.3 DSC curve of sPS1 blended with PBMA



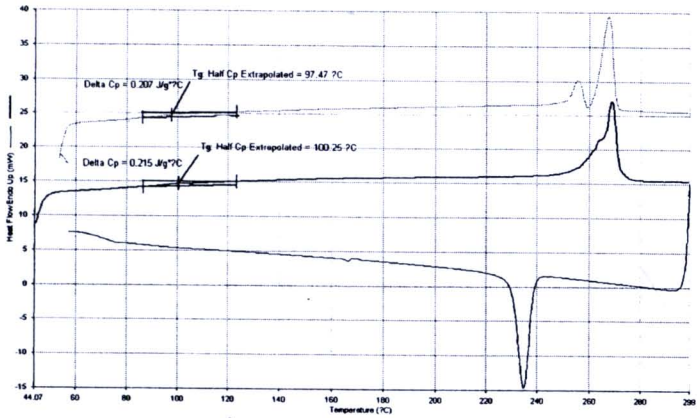
รูปที่ C.4 DSC curve of sPS1 blended with PEMA



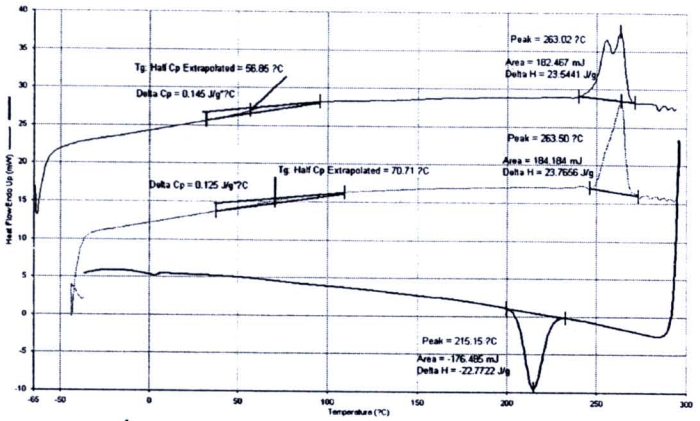
รูปที่ C.5 DSC curve of sPS1 blended with PHMA



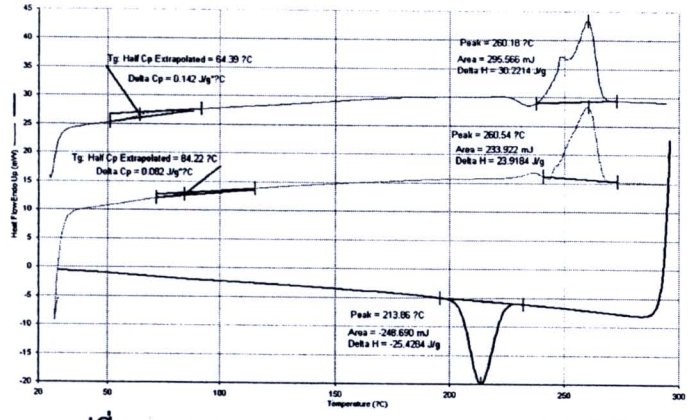
รูปที่ C.6 DSC curve of sPS1 blended with PaMS



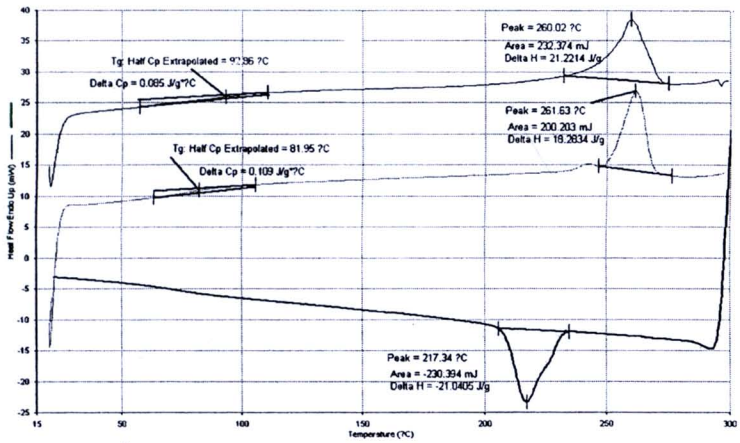
รูปที่ C.7 DSC curve of sPS2



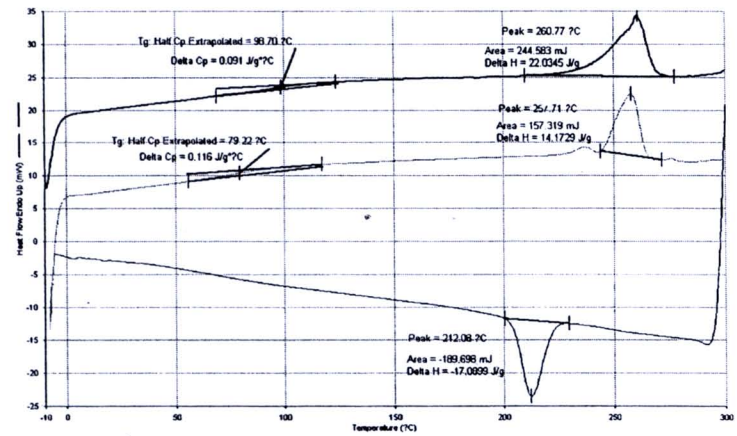
รูปที่ C.8 DSC curve of sPS2 blended with PIP



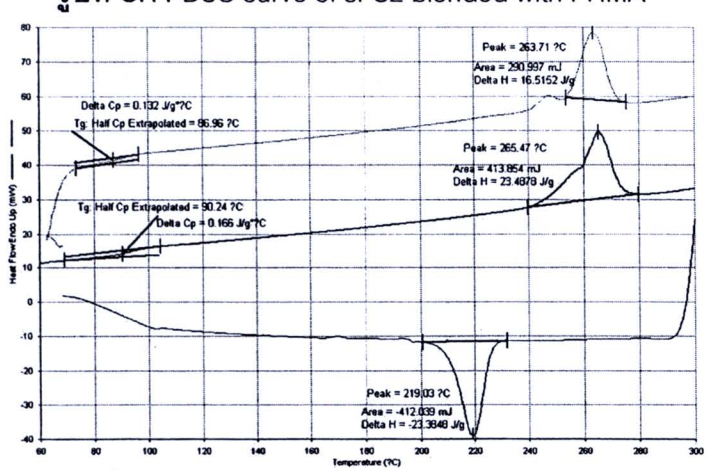
รูปที่ C.9 DSC curve of sPS2 blended with PBMA



รูปที่ C.10 DSC curve of sPS2 blended with PEMA

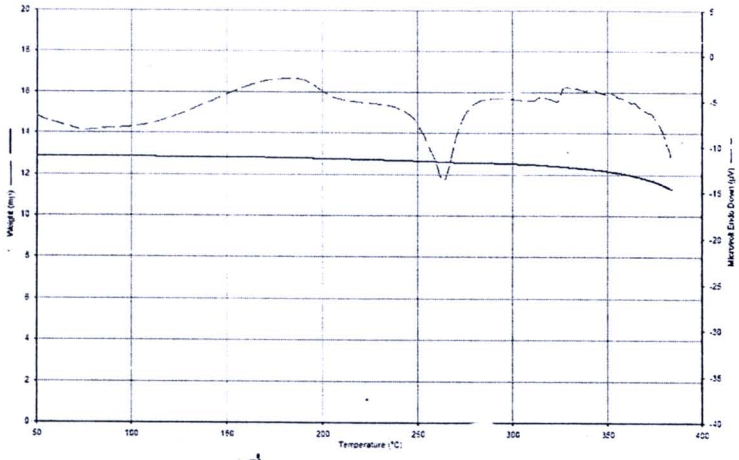


รูปที่ C.11 DSC curve of sPS2 blended with PHMA

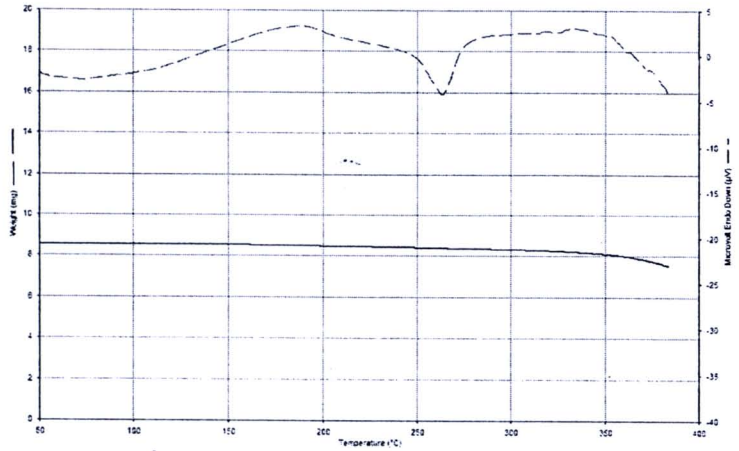


รูปที่ C.12 DSC curve of sPS2 blended with PaMS

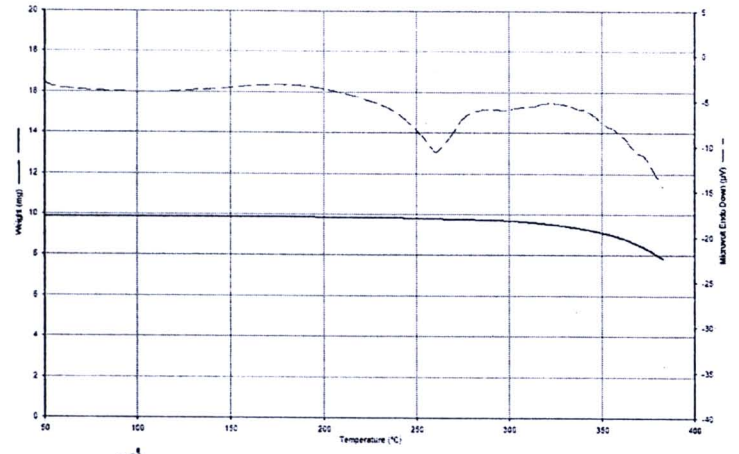
The Data of TGA Characterization



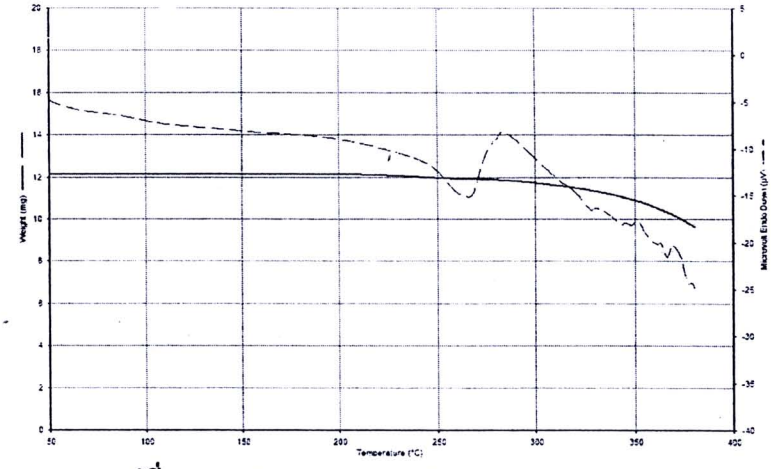
รูปที่ C.13 TGA curve of sPS



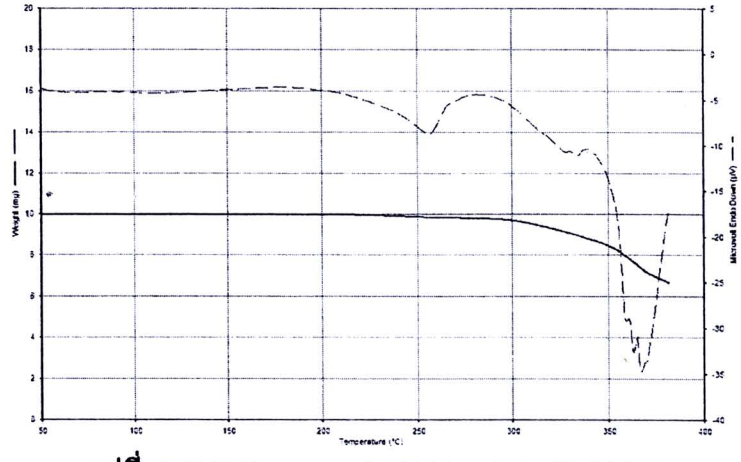
รูปที่ C.14 TGA curve of sPS blended with PIP



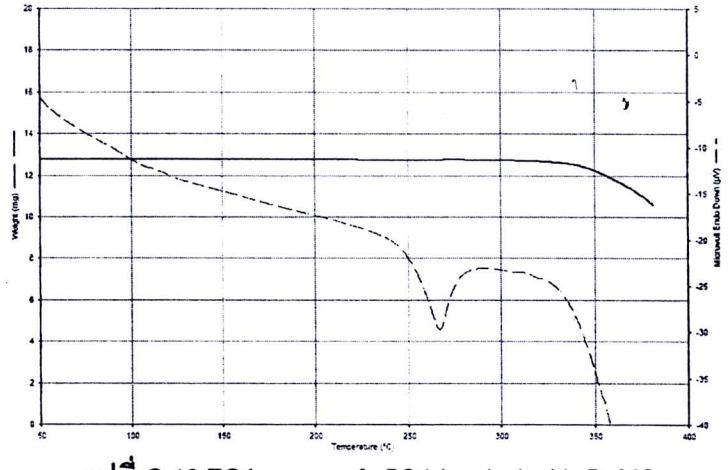
รูปที่ C.15 TGA curve of sPS blended with PBMA



รูปที่ C.16 TGA curve of sPS blended with PEMA



รูปที่ C.17 TGA curve of sPS blended with PHMA



รูปที่ C.18 TGA curve of sPS blended with PaMS

The Data of DMA Characterization

sPS1= sPS Mw. 31.7 x 10^4, sPS2= sPS Mw. 13.0 x 10^4

ตารางที่ C.1 DMA data of sPS1 for temperature 60 ^oC

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	^oC	Pa	Pa	μm		mN	min
100	62.05358	3590717564	1.56E+08	325.7563	0.057544	9806.65	0.133333
50	61.97859	3590717564	2.17E+08	327.8397	0.073696	9806.65	0.233333
20	61.90699	3594178154	2.14E+08	328.5341	0.071507	9806.65	0.350000
10	61.82243	3579891231	2.1E+08	328.5341	0.07038	9806.65	0.450000
5	61.74651	3545210769	2.13E+08	328.5341	0.072006	9806.65	0.566667
2	61.64837	3522528000	2.23E+08	329.2285	0.075972	9806.65	0.716667
1	61.50456	3496106077	2.27E+08	329.2285	0.077997	9806.65	0.900000
0.5	61.34686	3474709154	2.35E+08	329.923	0.081323	9806.65	1.116667
0.2	61.05954	3442222385	2.51E+08	330.6174	0.087388	9806.65	1.533333
0.1	60.55433	3426128077	2.58E+08	331.3119	0.090357	9806.65	2.283333
0.05	59.81489	3412839923	2.67E+08	332.7008	0.094054	9806.65	3.383333
0.02	58.13942	3405226385	2.73E+08	334.7841	0.096167	9806.65	5.966667
0.01	56.02696	3289889006	1.85E+08	336.173	0.062098	9806.65	11.05000

ตารางที่ C.2 DMA data of sPS1 for temperature 80 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	81.53671	3426595533	1.83E+08	345.8951	0.069175	9806.65	0.133333
50	81.42533	3357376142	2.25E+08	350.0618	0.07971	9806.65	0.233333
20	81.30535	3347080769	2.32E+08	350.7562	0.081492	9806.65	0.350000
10	81.18936	3308673462	2.33E+08	351.4507	0.082015	9806.65	0.450000
5	81.0654	3256579615	2.38E+08	352.8395	0.085069	9806.65	0.566667
2	80.91781	3235936569	2.55E+08	353.534	0.092406	9806.65	0.716667
1	80.72418	3169567463	2.73E+08	354.9229	0.100446	9806.65	0.900000
0.5	80.50755	3111716337	2.99E+08	356.3117	0.111842	9806.65	1.116667
0.2	80.11018	3047894990	3.6E+08	358.3951	0.138288	9806.65	1.533333
0.1	79.9632	3019951720	4.23E+08	362.5617	0.16677	9806.65	2.283333
0.05	80.31148	2904022654	5.21E+08	370.895	0.21346	9806.65	3.383333
0.02	80.02028	2818382931	7.64E+08	379.9227	0.345265	9806.65	5.966667
0.01	78.37097	2710191632	7.23E+08	396.5892	0.309062	9806.65	11.05000

ตารางที่ C.3 DMA data of sPS1 for temperature 90 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	90.7568	2930893245	91434802	707.6984	0.030568	9806.65	0.133333
50	90.77919	2904022654	1.42E+08	707.0039	0.042952	9806.65	0.233333
20	90.80066	2877398415	1.32E+08	707.0039	0.039469	9806.65	0.333333
10	90.82857	2837212500	1.3E+08	707.0039	0.0392	9806.65	0.450000
5	90.85157	2801813077	1.35E+08	707.0039	0.04135	9806.65	0.566667
2	90.86722	2757295962	1.5E+08	707.6984	0.047124	9806.65	0.700000
1	90.88531	2717085769	1.59E+08	707.6984	0.051132	9806.65	0.883333
0.5	90.90617	2673349615	1.69E+08	707.6984	0.055699	9806.65	1.100000
0.2	90.91414	2602017115	1.89E+08	707.6984	0.064304	9806.65	1.516667
0.1	90.85802	2535510577	2.09E+08	708.3928	0.073552	9806.65	2.266667
0.05	90.62522	2438796154	2.27E+08	708.3928	0.082148	9806.65	3.350000
0.02	89.86826	2213286923	2.55E+08	709.0872	0.095629	9806.65	5.933333
0.01	89.51218	1986094917	2.08E+08	709.0872	0.076096	9806.65	11.01667

ตารางที่ C.4 DMA data of sPS1 for temperature 100.25 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	100.8889	2685344446	1.2E+08	684.7819	0.042705	9806.65	0.133333
50	100.8224	2606153550	1.93E+08	684.7819	0.063865	9806.65	0.233333
20	100.7663	2558585887	2.06E+08	684.7819	0.069434	9806.65	0.333333
10	100.6982	2460367604	2.22E+08	685.4763	0.077059	9806.65	0.450000
5	100.6292	2365919697	2.38E+08	685.4763	0.086315	9806.65	0.566667
2	100.5565	2275097431	2.67E+08	686.1707	0.103531	9806.65	0.700000
1	100.4681	2186257327	2.85E+08	686.1707	0.117482	9806.65	0.883333
0.5	100.3442	2035228846	3.04E+08	686.8652	0.134364	9806.65	1.100000
0.2	100.163	1827662192	3.2E+08	686.8652	0.157735	9806.65	1.516667
0.1	99.86422	1671149596	3.28E+08	687.5596	0.176539	9806.65	2.266667
0.05	99.62928	1455459081	3.28E+08	688.254	0.195474	9806.65	3.366667
0.02	99.65995	1196740531	3.13E+08	688.9485	0.218023	9806.65	5.950000
0.01	100.3856	1025651926	2.74E+08	691.0318	0.219868	9806.65	11.03333

ตารางที่ C.5 DMA data of sPS1 for temperature 110 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	110.743	2365919697	2.56E+08	657.6987	0.112228	9806.65	0.133333
50	110.6183	2103778440	3.35E+08	659.0876	0.14656	9806.65	0.233333
20	110.4995	1892343619	3.53E+08	660.4764	0.170368	9806.65	0.333333
10	110.373	1733803998	3.57E+08	661.8653	0.190473	9806.65	0.450000
5	110.2418	1555965632	3.61E+08	662.5598	0.215509	9806.65	0.566667
2	110.0943	1419252212	3.34E+08	663.2542	0.235306	9806.65	0.716667
1	109.9094	1245981538	3.09E+08	663.9487	0.24821	9806.65	0.900000
0.5	109.7045	1093139904	2.79E+08	664.6431	0.255518	9806.65	1.116667
0.2	109.3913	922816635	2.38E+08	665.3375	0.258444	9806.65	1.533333
0.1	109.0259	814377212	2.08E+08	666.7264	0.254921	9806.65	2.283333
0.05	108.9076	713809087	1.76E+08	668.8097	0.246365	9806.65	3.383333
0.02	109.7807	594419712	1.34E+08	672.2819	0.225011	9806.65	5.966667
0.01	111.2284	507029087	97330980	678.5319	0.191963	9806.65	11.05000

ตารางที่ C.6 DMA data of sPS1 for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	119.7255	1054386896	3.33E+08	676.4485	0.24504	9806.65	0.133333
50	119.8147	893305484	3.27E+08	678.5319	0.27471	9806.65	0.233333
20	119.9277	803526122	2.74E+08	679.9208	0.28382	9806.65	0.333333
10	120.0659	721107479	2.3E+08	681.3096	0.278977	9806.65	0.450000
5	120.202	654636174	1.91E+08	682.6985	0.267632	9806.65	0.566667
2	120.3721	603180385	1.47E+08	683.3929	0.243264	9806.65	0.716667
1	120.5949	537380865	1.19E+08	684.0874	0.221428	9806.65	0.900000
0.5	120.847	488559471	95919700	685.4763	0.196332	9806.65	1.116667
0.2	121.3164	442017115	72817362	683.3929	0.164739	8878.284	1.533333
0.1	121.9518	415128125	58876689	680.6152	0.141828	7997.734	2.283333
0.05	122.4387	395507572	48728188	677.8375	0.123204	7147.645	3.366667
0.02	120.8822	385519519	43163741	675.0597	0.111963	6271.995	5.966667
0.01	118.0439	372391706	50070276	666.7264	0.124707	5406.057	11.05

ตารางที่ C.7 DMA data of sPS1 for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	139.934	469894109	1.06E+08	699.3651	0.212364	9806.65	0.130000
50	139.8521	422668614	84492776	702.1428	0.180521	9806.65	0.283333
20	139.8065	413999675	60997452	702.1428	0.142342	9371.608	0.383333
10	139.7556	398107171	48265499	697.2817	0.117453	8243.77	0.500000
5	139.714	390840896	38974706	693.1151	0.09792	7291.044	0.616667
2	139.6647	384794808	30449609	689.6429	0.079132	6440.79	0.766667
1	139.6062	378129832	26209582	683.3929	0.069314	5303.915	0.95000
0.5	139.5562	371051058	23241465	683.3929	0.062637	5276.568	1.166667
0.2	139.4866	363520745	20917097	682.0041	0.05754	4813.593	1.583333
0.1	139.4997	358476899	19947835	681.3096	0.055646	4545.61	2.333333
0.05	139.7778	353122139	19440174	680.6152	0.055052	4357.7	3.416667
0.02	140.8038	344555457	18510422	680.6152	0.053723	4287.002	6.000000
0.01	141.3851	339691707	18824222	681.3096	0.055416	4288.004	11.08333

ตารางที่ C.8 DMA data of sPS1 for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.7761	378459567	33569011	704.9206	0.088699	4965.342	0.133333
50	159.8318	373057476	27511505	706.3095	0.073746	4908.842	0.233333
20	159.8808	364929639	21261895	705.6151	0.058263	4585.677	0.350000
10	159.9355	358947115	18584639	704.9206	0.051775	4418.334	0.450000
5	159.9893	353444303	16630323	704.9206	0.047052	4292.826	0.566667
2	160.0478	346351298	16067820	704.2261	0.046392	4162.859	0.716667
1	160.1494	341142837	15850056	704.2261	0.046462	4096.967	0.900000
0.5	160.2395	335936538	15976369	704.2261	0.047558	4030.562	1.100000
0.2	160.4211	328952043	16447781	704.2261	0.050001	3957.634	1.516667
0.1	160.7235	323206563	17040376	704.2261	0.052723	3908.926	2.266667
0.05	161.0519	317547668	17729333	704.9206	0.055832	3859.205	3.350000
0.02	161.3691	308188365	20548131	705.6151	0.066674	3787.699	5.933333
0.01	161.3024	306246226	18861265	706.3095	0.061589	3741.898	11.03333

ตารางที่ C.9 DMA data of sPS1 for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	179.4777	334206394	16723697	724.3649	0.05004	3723.911	0.133333
50	179.5366	330295601	15413254	727.8371	0.046665	3986.767	0.233333
20	179.5919	325264808	14522580	727.8371	0.044648	3849.994	0.333333
10	179.6489	320948365	14179599	728.5316	0.04418	3807.708	0.450000
5	179.704	316441034	14086659	728.5316	0.044516	3736.679	0.566667
2	179.7705	310302212	14380658	728.5316	0.046344	3676.599	0.700000
1	179.8523	305475433	14777162	728.5316	0.048374	3628.592	0.883333
0.5	179.9484	300567788	15197153	728.5316	0.050561	3580.442	1.100000
0.2	180.1228	293835288	15937390	728.5316	0.054239	3515.749	1.516667
0.1	180.381	288499351	16546418	728.5316	0.057353	3464.076	2.266667
0.05	180.6789	283011514	17268154	729.226	0.061016	3413.519	3.350000
0.02	180.8428	276551442	17876310	729.9204	0.06464	3310.581	5.933333
0.01	180.6324	272540048	17598663	729.9204	0.064573	3288.044	11.01667

ตารางที่ C.10 DMA data of sPS1 blended with PIP for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1161	2.41E+09	1.02E+08	-1024.23	0.057112	9806.65	0.116667
50	60.2951	2.49E+09	1.09E+08	-1024.23	0.059027	9806.65	0.233333
20	60.45095	2.5E+09	1.03E+08	-1024.23	0.055469	9806.65	0.333333
10	60.60649	2.48E+09	99449250	-1024.23	0.054029	9615.176	0.433333
5	60.74567	2.47E+09	99430586	-1024.23	0.054446	9301.882	0.550000
2	60.90214	2.44E+09	1.01E+08	-1024.93	0.055969	9180.126	0.700000
1	61.08793	2.42E+09	1.02E+08	-1024.93	0.057101	9089.992	0.883333
0.5	61.24131	2.39E+09	1.03E+08	-1024.93	0.058295	9030.851	1.100000
0.2	61.37741	2.36E+09	1.06E+08	-1024.93	0.060333	9191.332	1.516667
0.1	61.18854	2.34E+09	1.07E+08	-1024.93	0.061765	9266.926	2.266667
0.05	60.34386	2.32E+09	1.1E+08	-1024.93	0.063993	9315.082	3.333333
0.02	56.82627	2.29E+09	1.1E+08	-1025.62	0.064735	9546.487	5.933333
0.01	53.17033	2.32E+09	1.05E+08	-1027.71	0.061213	9260.242	11.01667

ตารางที่ C.11 DMA data of sPS1 blended with PIP for temperature 65 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	65.83502	2.24E+09	97334359	-1022.15	0.054689	9806.65	0.133333
50	65.9211	2.32E+09	1.06E+08	-1020.76	0.057771	9806.65	0.233333
20	65.98713	2.32E+09	1.01E+08	-1020.76	0.055112	9806.65	0.333333
10	66.05624	2.29E+09	99257148	-1020.76	0.054622	9806.65	0.450000
5	66.10313	2.27E+09	1E+08	-1020.07	0.055852	9806.65	0.566667
2	66.16824	2.23E+09	1.01E+08	-1020.07	0.056793	9806.65	0.716667
1	66.23395	2.2E+09	1.02E+08	-1020.07	0.058532	9806.65	0.883333
0.5	66.28393	2.18E+09	1.04E+08	-1020.07	0.060321	9806.65	1.100000
0.2	66.33114	2.14E+09	1.08E+08	-1019.37	0.063807	9806.65	1.516667
0.1	66.12751	2.11E+09	1.12E+08	-1019.37	0.066471	9806.65	2.266667
0.05	65.48824	2.09E+09	1.15E+08	-1018.68	0.069621	9806.65	3.350000
0.02	63.68365	2.05E+09	1.22E+08	-1017.99	0.075218	9806.65	5.950000
0.01	66.29751	2E+09	93132461	-1017.29	0.058717	9806.65	11.03333

ตารางที่ C.12 DMA data of sPS1 blended with PIP for temperature 70.71 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	72.3009	2.04E+09	1.04E+08	-1031.87	0.046963	9806.65	0.133333
50	72.39113	2.11E+09	1.24E+08	-1029.79	0.053971	9806.65	0.233333
20	72.47522	2.11E+09	1.2E+08	-1029.79	0.052425	9806.65	0.333333
10	72.55685	2.09E+09	1.2E+08	-1029.1	0.053118	9806.65	0.450000
5	72.62345	2.06E+09	1.23E+08	-1029.1	0.055059	9806.65	0.566667
2	72.70539	2.01E+09	1.28E+08	-1028.4	0.058606	9806.65	0.700000
1	72.7769	1.97E+09	1.33E+08	-1028.4	0.061883	9806.65	0.883333
0.5	72.82386	1.93E+09	1.39E+08	-1027.71	0.065973	9806.65	1.116667
0.2	72.83675	1.88E+09	1.5E+08	-1027.01	0.073233	9806.65	1.533333
0.1	72.65138	1.79E+09	1.57E+08	-1026.32	0.079008	9806.65	2.283333
0.05	71.96454	1.74E+09	1.68E+08	-1025.62	0.086194	9806.65	3.366667
0.02	69.50132	1.6E+09	1.76E+08	-1024.23	0.093011	9806.65	5.950000
0.01	67.16569	1.49E+09	1.59E+08	-1024.23	0.083377	9806.65	11.03333

ตารางที่ C.13 DMA data of sPS1 blended with PIP for temperature 85 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	84.91834	1.77E+09	2.08E+08	-1027.71	0.115555	9806.65	0.133333
50	84.98602	1.8E+09	2.2E+08	-1020.76	0.119783	9806.65	0.233333
20	85.05033	1.77E+09	2.16E+08	-1017.29	0.119417	9806.65	0.333333
10	85.13547	1.74E+09	2.12E+08	-1015.21	0.119889	9806.65	0.450000
5	85.21294	1.7E+09	2.11E+08	-1013.12	0.121349	9806.65	0.566667
2	85.30727	1.63E+09	2.12E+08	-1011.74	0.127605	9806.65	0.716667
1	85.41078	1.58E+09	2.14E+08	-1010.35	0.132812	9806.65	0.900000
0.5	85.51031	1.52E+09	2.15E+08	-1008.96	0.138618	9806.65	1.116667
0.2	85.65823	1.44E+09	2.21E+08	-1007.57	0.149787	9806.65	1.533333
0.1	85.71549	1.32E+09	2.25E+08	-1005.49	0.158059	9806.65	2.283333
0.05	85.3036	1.24E+09	2.31E+08	-1002.71	0.167204	9806.65	3.366667
0.02	83.22298	1.11E+09	2.39E+08	-1000.62	0.177984	9806.65	5.966667
0.01	81.90892	1E+09	2.29E+08	-999.235	0.172391	9806.65	11.05000

ตารางที่ C.14 DMA data of sPS1 blended with PIP for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	100.2038	1.4E+09	2.48E+08	-836.736	0.189721	9806.65	0.133333
50	100.3513	1.32E+09	2.5E+08	-828.403	0.195146	9806.65	0.233333
20	100.5163	1.22E+09	2.39E+08	-824.931	0.195503	9806.65	0.350000
10	100.6801	1.16E+09	2.3E+08	-824.931	0.199043	9151.409	0.450000
5	100.8438	1.09E+09	2.22E+08	-824.931	0.204334	8756.395	0.566667
2	101.0362	9.88E+08	2.11E+08	-826.32	0.213736	8226.543	0.716667
1	101.269	9.14E+08	2E+08	-827.708	0.218856	7789.597	0.900000
0.5	101.5198	8.42E+08	1.88E+08	-829.097	0.222657	7340.775	1.116667
0.2	101.9156	7.52E+08	1.7E+08	-831.875	0.225986	6722.001	1.533333
0.1	102.481	6.59E+08	1.56E+08	-833.264	0.226498	6304.098	2.283333
0.05	102.6153	5.94E+08	1.43E+08	-836.042	0.22687	5758.893	3.366667
0.02	101.5183	5.41E+08	1.35E+08	-840.208	0.22854	4958.609	5.950000
0.01	99.24773	4.88E+08	1.33E+08	-842.292	0.229706	5643.928	11.05000

ตารางที่ C.15 DMA data of sPS1 blended with PIP for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	120.2316	7E+08	1.88E+08	-688.82	0.269077	5525.273	0.133333
50	120.215	6.4E+08	1.71E+08	-686.043	0.267049	5467.645	0.233333
20	120.206	5.63E+08	1.46E+08	-688.82	0.259733	4843.024	0.333333
10	120.1971	5.12E+08	1.28E+08	-692.293	0.249546	4435.103	0.450000
5	120.1807	4.67E+08	1.11E+08	-695.07	0.236944	4077.832	0.566667
2	120.1662	4.18E+08	90799250	-698.543	0.217189	3586.561	0.716667
1	120.1554	3.87E+08	77533289	-699.932	0.200105	3401.087	0.900000
0.5	120.1246	3.63E+08	66275133	-702.015	0.182825	3200.543	1.116667
0.2	120.0508	3.36E+08	54161410	-703.404	0.161331	3036.965	1.533333
0.1	119.9869	3.2E+08	46908219	-705.487	0.146548	2906.298	2.283333
0.05	119.8619	3.07E+08	41350164	-706.181	0.134649	2797.544	3.366667
0.02	119.7197	2.93E+08	35518719	-707.57	0.121086	2679.429	5.950000
0.01	119.9721	2.85E+08	32611330	-710.348	0.114469	2431.156	11.05000

ตารางที่ C.16 DMA data of sPS1 blended with PIP for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	140.7719	3.6E+08	88699648	-671.459	0.246566	5732.294	0.133333
50	140.7772	3.41E+08	72794992	-666.598	0.213772	5173.414	0.233333
20	140.7741	3.17E+08	56386902	-669.376	0.177729	4595.755	0.350000
10	140.7625	3.03E+08	46945156	-672.848	0.154719	4231.921	0.450000
5	140.7497	2.93E+08	39822258	-675.626	0.136053	3900.586	0.566667
2	140.731	2.81E+08	33440547	-678.404	0.119076	3564.472	0.716667
1	140.7016	2.73E+08	30022619	-680.487	0.109872	3390.557	0.900000
0.5	140.6575	2.67E+08	27543730	-682.57	0.103256	3159.342	1.116667
0.2	140.5785	2.58E+08	25437625	-682.57	0.098411	3049.861	1.533333
0.1	140.4314	2.53E+08	24036766	-683.959	0.095038	2919.117	2.283333
0.05	140.2748	2.48E+08	23156504	-685.348	0.093476	2815.115	3.366667
0.02	140.1071	2.41E+08	22992252	-686.043	0.095429	2700.855	5.950000
0.01	140.1011	2.37E+08	22126271	-686.043	0.093385	2629.164	11.03333

ตารางที่ C.17 DMA data of sPS1 blended with PIP for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.5746	2.87E+08	33715336	-674.237	0.117374	2991.014	0.133333
50	159.6066	2.8E+08	28941049	-670.765	0.103227	3059.536	0.233333
20	159.6467	2.73E+08	25010131	-670.765	0.091721	2792.217	0.333333
10	159.6812	2.67E+08	23111113	-671.459	0.086623	2648.652	0.450000
5	159.7204	2.61E+08	21830402	-672.848	0.083656	2561.874	0.566667
2	159.7723	2.53E+08	20749229	-673.543	0.081872	2468.033	0.716667
1	159.8226	2.48E+08	20231168	-673.543	0.081603	2408.69	0.900000
0.5	159.8625	2.43E+08	19908633	-673.543	0.082047	2357.904	1.116667
0.2	159.9438	2.36E+08	19875318	-674.237	0.084345	2294.049	1.533333
0.1	160.075	2.31E+08	19879346	-674.237	0.086202	2252.091	2.283333
0.05	160.1845	2.26E+08	19984799	-674.237	0.088613	2212.327	3.366667
0.02	160.138	2.19E+08	19935947	-674.237	0.091055	2159.902	5.933333
0.01	159.9302	2.15E+08	19953348	-674.237	0.092924	2130.832	11.01667

ตารางที่ C.18 DMA data of sPS1 blended with PIP for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	179.1855	2.56E+08	22046697	-659.654	0.085993	2221.254	0.133333
50	179.2269	2.49E+08	21306006	-656.182	0.085497	2421.229	0.233333
20	179.2689	2.44E+08	19921627	-654.098	0.081774	2539.612	0.350000
10	179.3138	2.39E+08	19116389	-654.098	0.080024	2310.78	0.450000
5	179.3602	2.34E+08	18523152	-654.098	0.079188	2268.932	0.566667
2	179.4245	2.27E+08	18234164	-654.098	0.080181	2213.611	0.716667
1	179.5028	2.23E+08	18124664	-654.793	0.081442	2172.635	0.900000
0.5	179.5986	2.18E+08	18124371	-654.793	0.083223	2133.512	1.116667
0.2	179.7285	2.11E+08	18340252	-654.793	0.086824	2081.532	1.533333
0.1	179.9411	2.06E+08	18431035	-654.793	0.089347	2043.001	2.283333
0.05	180.1429	2.01E+08	18454924	-654.793	0.091673	2006.643	3.350000
0.02	180.1604	1.95E+08	18513512	-654.793	0.094719	1960.305	5.933333
0.01	180.043	1.92E+08	17745412	-654.793	0.0926	1927.375	11.01667

ตารางที่ C.19 DMA data of sPS1 blended with PBMA for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1482	1.93E+09	91379870	85.48012	0.047423	6200	0.133333
50	60.09882	2E+09	1.01E+08	89.64676	0.05037	5970.336	0.233333
20	60.0445	2E+09	96669544	90.3412	0.048249	5959.019	0.350000
10	59.98988	1.97E+09	94502676	90.3412	0.047895	5959.019	0.450000
5	59.93649	1.94E+09	93664408	90.3412	0.04824	5959.019	0.566667
2	59.86643	1.9E+09	95869668	90.3412	0.05059	5959.019	0.716667
1	59.76953	1.87E+09	1.01E+08	91.03564	0.054323	5959.019	0.900000
0.5	59.64732	1.83E+09	1.03E+08	91.03564	0.056467	5959.019	1.116667
0.2	59.39888	1.78E+09	1.1E+08	91.03564	0.061852	5959.019	1.533333
0.1	58.91682	1.74E+09	1.14E+08	91.03564	0.065862	5959.019	2.283333
0.05	58.16072	1.65E+09	1.22E+08	91.73008	0.071811	5959.019	3.366667
0.02	56.54018	1.53E+09	1.31E+08	92.42452	0.079305	5959.019	5.950000
0.01	56.29823	1.45E+09	1.21E+08	92.42452	0.07415	5959.019	11.03333

ตารางที่ C.20 DMA data of sPS1 blended with PBMA for temperature 80 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	80.85674	1.82E+09	1.65E+08	850.753	0.084399	6200	0.133333
50	80.79568	1.76E+09	1.44E+08	855.6141	0.074967	6000.305	0.250000
20	80.73799	1.71E+09	1.49E+08	856.3085	0.080439	5999.559	0.350000
10	80.68368	1.65E+09	1.52E+08	857.0029	0.084782	5999.559	0.466667
5	80.62016	1.62E+09	1.54E+08	857.0029	0.089866	5999.559	0.583333
2	80.54928	1.48E+09	1.6E+08	857.6974	0.099489	5999.559	0.716667
1	80.44373	1.37E+09	1.62E+08	857.6974	0.105966	5999.559	0.900000
0.5	80.32467	1.3E+09	1.62E+08	857.6974	0.112253	5999.559	1.116667
0.2	80.08226	1.14E+09	1.62E+08	858.3918	0.121541	5999.559	1.533333
0.1	79.68459	1.02E+09	1.61E+08	859.0863	0.12831	5999.559	2.300000
0.05	79.18044	9.46E+08	1.6E+08	859.7807	0.135217	5999.559	3.383333
0.02	78.52409	8.39E+08	1.55E+08	861.1696	0.142542	5999.559	5.966667
0.01	78.96503	7.69E+08	1.41E+08	862.5585	0.14172	5999.559	11.05000

ตารางที่ C.21 DMA data of sPS1 blended with PBMA for temperature 84.22 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	85.33208	1.71E+09	1.58E+08	880.6139	0.097545	9806.65	0.133333
50	85.32993	1.56E+09	1.72E+08	882.6973	0.110308	9806.65	0.233333
20	85.32472	1.47E+09	1.72E+08	884.0861	0.117163	9806.65	0.333333
10	85.31615	1.38E+09	1.71E+08	884.7806	0.123688	9806.65	0.450000
5	85.30022	1.29E+09	1.69E+08	885.475	0.130757	9806.65	0.566667
2	85.28828	1.17E+09	1.66E+08	886.1694	0.141904	9806.65	0.716667
1	85.27634	1E+09	1.58E+08	886.8639	0.157591	9806.65	0.900000
0.5	85.23285	9.14E+08	1.44E+08	888.9472	0.157377	9806.65	1.116667
0.2	85.16456	8.28E+08	1.35E+08	890.3361	0.163055	9806.65	1.533333
0.1	85.01022	7.7E+08	1.28E+08	892.4194	0.166444	9806.65	2.283333
0.05	84.77502	7.24E+08	1.22E+08	893.1138	0.168045	9105.187	3.383333
0.02	84.27431	6.53E+08	1.13E+08	893.1138	0.168802	8504.206	5.950000
0.01	84.2936	6.18E+08	1.04E+08	893.8083	0.162267	7942.243	11.05000

ตารางที่ C.22 DMA data of sPS1 blended with PBMA for temperature 90 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	90.59547	1.27E+09	1.48E+08	899.3638	0.116218	9806.65	0.133333
50	90.56235	1.22E+09	1.67E+08	900.0582	0.136497	9806.65	0.233333
20	90.52493	1.13E+09	1.65E+08	901.4471	0.146263	9806.65	0.350000
10	90.49641	1.05E+09	1.59E+08	902.836	0.152105	9806.65	0.450000
5	90.45807	9.7E+08	1.53E+08	903.5305	0.158112	9806.65	0.566667
2	90.41022	8.75E+08	1.44E+08	904.2249	0.164104	9756.174	0.716667
1	90.35287	8.13E+08	1.35E+08	902.1415	0.166229	8670.738	0.900000
0.5	90.29152	7.55E+08	1.26E+08	901.4471	0.167349	8101.237	1.116667
0.2	90.13909	6.85E+08	1.15E+08	899.3638	0.167235	7477.493	1.533333
0.1	89.93022	6.4E+08	1.06E+08	897.9749	0.165396	7056.695	2.283333
0.05	89.69466	6E+08	98040456	897.2805	0.163389	6704.466	3.383333
0.02	89.48273	5.52E+08	88397988	897.2805	0.160286	6294.627	5.950000
0.01	89.88882	5.13E+08	77688828	897.2805	0.151345	6018.605	11.03333

ตารางที่ C.23 DMA data of sPS1 blended with PBMA for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	100.262	9.18E+08	1.55E+08	925.7525	0.177938	9806.65	0.133333
50	100.2648	7.89E+08	1.52E+08	929.9192	0.191181	9806.65	0.241546
20	100.2682	7.28E+08	1.36E+08	932.0025	0.192072	9706.028	0.333333
10	100.2666	6.79E+08	1.24E+08	929.9192	0.190701	8605.374	0.450000
5	100.2623	6.46E+08	1.12E+08	927.8358	0.187453	8103.616	0.566667
2	100.2657	6.19E+08	96758184	925.0581	0.180394	7460.711	0.716667
1	100.2626	5.96E+08	86376621	924.3636	0.173893	7229.591	0.900000
0.5	100.259	5.71E+08	77085423	922.2803	0.166617	6797.596	1.116667
0.2	100.2617	5.27E+08	66700202	922.2803	0.157493	6608.468	1.533333
0.1	100.2556	5.01E+08	60072734	920.8914	0.150591	6240.991	2.283333
0.05	100.2629	4.82E+08	54335391	920.197	0.143965	5903.473	3.383333
0.02	100.4016	4.4E+08	47759850	919.5026	0.135437	5482.351	5.966667
0.01	100.5144	4.1E+08	42954798	918.8081	0.127277	5142.337	11.05000

ตารางที่ C.24 DMA data of sPS1 blended with PBMA for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	120.2208	6.38E+08	1.74E+08	575.0603	0.197712	5880.429	0.133333
50	120.1298	6.07E+08	1.59E+08	594.5046	0.200681	9806.65	0.233333
20	120.0385	5.89E+08	1.32E+08	584.7825	0.183313	6021.776	0.350000
10	119.9508	5.55E+08	1.13E+08	584.088	0.170045	6021.776	0.466667
5	119.869	5.43E+08	96598792	584.088	0.156984	6021.776	0.566667
2	119.7801	5.22E+08	78302764	584.088	0.138761	6021.776	0.716667
1	119.6678	4.97E+08	67490445	584.7825	0.126687	6021.776	0.900000
0.5	119.5632	4.86E+08	58607939	585.4769	0.115817	6021.776	1.116667
0.2	119.4231	4.53E+08	50098191	586.1714	0.105193	6021.776	1.533333
0.1	119.362	4.36E+08	44904621	587.5602	0.098426	6021.776	2.283333
0.05	119.5811	4.14E+08	40897052	589.6436	0.093437	6021.776	3.366667
0.02	120.6773	3.98E+08	37389468	591.7269	0.090193	6021.776	5.966667
0.01	121.5016	3.74E+08	34536911	596.588	0.086576	5851.247	11.05000

ตารางที่ C.25 DMA data of sPS1 blended with PBMA for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	140.8597	4.62E+08	52848275	626.4489	0.1143	7465.307	0.133333
50	140.8413	4.5E+08	45782569	628.5322	0.101723	6825.542	0.233333
20	140.8266	4.33E+08	36535941	628.5322	0.084441	6586.728	0.333333
10	140.8119	4.21E+08	31909426	628.5322	0.07574	6208.914	0.450000
5	140.7981	4.11E+08	28887903	627.8378	0.070246	5878.668	0.566667
2	140.765	3.99E+08	26167203	626.4489	0.065597	5527.138	0.716667
1	140.7435	3.9E+08	25023145	625.7545	0.064111	5310.419	0.900000
0.5	140.725	3.82E+08	24225781	625.06	0.063341	5125.988	1.116667
0.2	140.701	3.72E+08	23883655	624.3655	0.064143	4920.024	1.533333
0.1	140.7147	3.65E+08	24058466	624.3655	0.06596	4913.906	2.283333
0.05	140.8116	3.58E+08	24062261	624.3655	0.067303	4744.387	3.366667
0.02	141.1393	3.48E+08	24082127	624.3655	0.069152	4528.979	5.950000
0.01	141.5033	3.42E+08	23601749	625.06	0.068939	4393.244	11.03333

ตารางที่ C.26 DMA data of sPS1 blended with PBMA for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	160.5002	4.12E+08	26792133	244.5069	0.065098	6065.798	0.116667
50	160.4391	4.08E+08	24371648	236.868	0.059744	4292.32	0.233333
20	160.3686	4.01E+08	22042495	234.7847	0.054989	4015.556	0.333333
10	160.2965	3.94E+08	21008374	235.4792	0.053365	4299.357	0.450000
5	160.2193	3.87E+08	20217043	235.4792	0.052302	4227.502	0.566667
2	160.1288	3.77E+08	19849318	235.4792	0.05261	4130.894	0.700000
1	160.0393	3.7E+08	19791961	235.4792	0.053432	4056.834	0.883333
0.5	159.927	3.57E+08	22049118	243.8124	0.061707	6200.000	1.100000
0.2	159.7986	3.47E+08	23252248	245.8958	0.066984	6200.000	1.533333
0.1	159.7201	3.4E+08	23310850	246.5902	0.068638	5842.711	2.283333
0.05	159.9267	3.32E+08	23973785	248.6735	0.072207	5842.711	3.366667
0.02	161.0155	3.21E+08	24204982	250.0624	0.075486	5573.512	5.950000
0.01	161.5773	3.13E+08	24222927	254.229	0.077465	5573.512	11.03333

ตารางที่ C.27 DMA data of sPS1 blended with PBMA for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	180.3842	3.52E+08	19466337	268.8123	0.055278	4082.757	0.133333
50	180.373	3.46E+08	19222508	271.59	0.055587	4258.343	0.233333
20	180.3609	3.39E+08	18453924	272.9789	0.054436	4292.207	0.350000
10	180.3558	3.33E+08	18176556	272.9789	0.054621	4232.135	0.450000
5	180.346	3.26E+08	18175068	272.9789	0.055674	4199.316	0.566667
2	180.3266	3.18E+08	18261629	272.9789	0.057411	4110.425	0.700000
1	180.304	3.12E+08	18407822	272.9789	0.059052	4046.258	0.883333
0.5	180.2995	3.06E+08	18556454	272.9789	0.06072	3924.034	1.100000
0.2	180.3008	2.97E+08	18816519	272.9789	0.063327	3828.279	1.516667
0.1	180.3402	2.91E+08	18914651	272.9789	0.065015	3755.312	2.266667
0.05	180.4319	2.84E+08	18867701	272.9789	0.066333	3681.251	3.350000
0.02	180.6343	2.76E+08	18453125	272.2845	0.066744	3576.718	5.933333
0.01	180.7282	2.71E+08	18275192	272.2845	0.06733	3503.815	11.01667

ตารางที่ C.28 DMA data of sPS1 blended with PEMA for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	63.90271	3.14E+09	1.14E+08	18.11944	0.036407	6200	0.133333
50	63.84655	3.23E+09	1.38E+08	20.20276	0.042608	6200	0.233333
20	63.78145	3.23E+09	1.27E+08	20.20276	0.039256	6174.71	0.333333
10	63.71389	3.19E+09	1.28E+08	20.20276	0.04019	6174.71	0.450000
5	63.65218	3.13E+09	1.36E+08	20.20276	0.043419	6174.71	0.566667
2	63.56055	3.04E+09	1.44E+08	20.8972	0.047418	6174.71	0.700000
1	63.45503	2.97E+09	1.51E+08	20.8972	0.050834	6174.71	0.883333
0.5	63.32915	2.89E+09	1.59E+08	20.8972	0.054934	6174.71	1.100000
0.2	63.07461	2.78E+09	1.74E+08	21.59164	0.062628	6174.71	1.516667
0.1	62.62231	2.69E+09	1.88E+08	22.28608	0.069883	6174.71	2.266667
0.05	61.936	2.61E+09	1.98E+08	22.98052	0.075704	6174.71	3.350000
0.02	60.21609	2.49E+09	2.13E+08	23.67496	0.085421	6174.71	5.950000
0.01	57.37067	2.49E+09	1.94E+08	25.06384	0.078122	6174.71	11.03333

ตารางที่ C.29 DMA data of sPS1 blended with PEMA for temperature 70 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	70.53992	2.66E+09	1.43E+08	40.34152	0.053762	9806.65	0.133333
50	70.55833	2.8E+09	1.91E+08	41.03596	0.06819	9806.65	0.233333
20	70.56876	2.79E+09	1.9E+08	41.7304	0.068082	9806.65	0.350000
10	70.57797	2.73E+09	1.95E+08	42.42484	0.071451	9806.65	0.450000
5	70.58749	2.64E+09	2.06E+08	43.11928	0.077802	9806.65	0.566667
2	70.57521	2.51E+09	2.18E+08	43.81372	0.086756	9806.65	0.716667
1	70.55526	2.41E+09	2.29E+08	44.50816	0.095057	9806.65	0.900000
0.5	70.53593	2.3E+09	2.4E+08	45.2026	0.104389	9806.65	1.116667
0.2	70.43158	2.14E+09	2.6E+08	46.59148	0.121238	9806.65	1.533333
0.1	70.1551	2.02E+09	2.71E+08	47.98036	0.134368	9806.65	2.300000
0.05	69.67313	1.9E+09	2.92E+08	51.45256	0.153376	9806.65	3.383333
0.02	68.40575	1.76E+09	3.15E+08	54.23032	0.179088	9806.65	5.966667
0.01	67.54305	1.74E+09	3.09E+08	60.48028	0.177398	9806.65	11.05000

ตารางที่ C.30 DMA data of sPS1 blended with PEMA for temperature 81.95 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	79.65697	1.93E+09	1.94E+08	113.2577	0.100801	6200	0.133333
50	79.78677	1.92E+09	2.24E+08	115.341	0.116452	6200	0.233333
20	79.90705	1.83E+09	2.32E+08	116.0355	0.127112	6001.315	0.333333
10	80.03532	1.72E+09	2.34E+08	116.7299	0.135871	6001.315	0.450000
5	80.16603	1.62E+09	2.37E+08	117.4244	0.146612	6001.315	0.566667
2	80.30872	1.47E+09	2.34E+08	118.1188	0.158798	6001.315	0.716667
1	80.4781	1.37E+09	2.32E+08	118.8132	0.170126	6001.315	0.900000
0.5	80.64931	1.26E+09	2.29E+08	119.5077	0.181599	6001.315	1.116667
0.2	80.91781	1.13E+09	2.23E+08	120.2021	0.198236	6001.315	1.533333
0.1	81.18538	1.03E+09	2.17E+08	121.591	0.21122	6001.315	2.283333
0.05	81.22036	9.39E+08	2.12E+08	123.6743	0.225441	6001.315	3.366667
0.02	80.34953	8.42E+08	2.04E+08	125.7576	0.242472	5966.188	5.966667
0.01	78.50906	8.18E+08	2.04E+08	127.841	0.249103	5906.429	11.05000

ตารางที่ C.31 DMA data of sPS1 blended with PEMA for temperature 90 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	90.9715	1.78E+09	1.97E+08	300.0621	0.110923	9806.65	0.133333
50	90.91599	1.77E+09	2.25E+08	302.1454	0.127214	9806.65	0.233333
20	90.86047	1.65E+09	2.28E+08	304.2287	0.138597	9806.65	0.333333
10	90.8074	1.54E+09	2.27E+08	305.6176	0.147568	9806.65	0.450000
5	90.74361	1.42E+09	2.26E+08	307.0065	0.159196	9806.65	0.566667
2	90.67491	1.27E+09	2.25E+08	308.3954	0.176424	9806.65	0.716667
1	90.57124	1.16E+09	2.24E+08	310.4787	0.192121	9806.65	0.900000
0.5	90.46665	1.06E+09	2.23E+08	313.9509	0.210693	9806.65	1.116667
0.2	90.26392	9.25E+08	2.29E+08	317.4231	0.247439	9806.65	1.533333
0.1	89.90384	8.21E+08	2.44E+08	325.0619	0.296511	9806.65	2.300000
0.05	89.51218	7.09E+08	2.66E+08	343.1174	0.375657	9806.65	3.383333
0.02	89.13339	5.52E+08	2.87E+08	366.0339	0.519566	9806.65	5.966667
0.01	89.85876	5.07E+08	2.34E+08	418.8113	0.462106	9806.65	11.05000

ตารางที่ C.32 DMA data of sPS1 blended with PEMA for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	100.0786	1.15E+09	2.19E+08	470.8943	0.190269	9806.65	0.133333
50	100.0369	1.09E+09	2.27E+08	476.4498	0.208697	9806.65	0.233333
20	99.99764	9.66E+08	2.14E+08	482.0054	0.221428	9806.65	0.333333
10	99.96789	8.74E+08	2.01E+08	486.172	0.230567	9806.65	0.450000
5	99.94121	7.89E+08	1.89E+08	489.6442	0.240078	9806.65	0.566667
2	99.90225	6.88E+08	1.75E+08	493.8109	0.253885	9806.65	0.716667
1	99.8587	6.29E+08	1.63E+08	500.0608	0.25887	9806.65	0.900000
0.5	99.8038	5.66E+08	1.57E+08	507.6996	0.277015	9806.65	1.116667
0.2	99.75227	5.07E+08	1.48E+08	517.4218	0.290787	9701.603	1.533333
0.1	99.67314	4.75E+08	1.35E+08	530.6161	0.284965	9001.76	2.283333
0.05	99.64861	4.48E+08	1.21E+08	541.7272	0.269899	7970.24	3.383333
0.02	99.96513	4.14E+08	1.07E+08	545.1994	0.257564	7042.031	5.966667
0.01	100.3065	3.92E+08	96604667	549.366	0.246156	6615.459	11.05000

ตารางที่ C.33 DMA data of sPS1 blended with PEMA for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	120.8634	5.38E+08	1.3E+08	595.8935	0.2422	9806.65	0.133333
50	120.8683	4.97E+08	1.18E+08	636.171	0.237023	9806.65	0.233333
20	120.8714	4.47E+08	1.02E+08	670.8931	0.227539	9806.65	0.350000
10	120.8742	4.17E+08	91982667	696.5873	0.220687	9258.49	0.466667
5	120.8668	3.91E+08	84164318	713.9483	0.215217	8667.262	0.583333
2	120.8615	3.64E+08	76372276	725.0594	0.210069	7773.847	0.716667
1	120.8662	3.46E+08	72352307	732.6982	0.209383	7296.789	0.900000
0.5	120.8557	3.31E+08	68880786	739.6426	0.208242	6778.24	1.133333
0.2	120.8541	3.12E+08	66591479	742.4203	0.213513	5980.827	1.550000
0.1	120.8476	3E+08	64481505	744.5037	0.215063	5307.886	2.3000000
0.05	120.8637	2.91E+08	62847891	747.9759	0.215942	5407.641	3.383333
0.02	121.0615	2.77E+08	61224380	750.0592	0.221214	4814.517	5.966667
0.01	121.4721	2.72E+08	60054995	753.5314	0.22056	4820.601	11.05000

ตารางที่ C.34 DMA data of sPS1 blended with PEMA for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	140.5051	3.77E+08	57949521	782.0034	0.153546	6319.144	0.133333
50	140.4779	3.64E+08	50129958	786.8645	0.137789	6027.768	0.233333
20	140.4629	3.48E+08	43729661	786.8645	0.12575	5313.033	0.333333
10	140.4507	3.36E+08	40853414	786.8645	0.121529	5002.919	0.450000
5	140.4404	3.25E+08	39535057	786.1701	0.121553	4732.019	0.566667
2	140.4142	3.11E+08	39776977	784.7812	0.127984	4440.07	0.700000
1	140.3732	3E+08	41052708	784.7812	0.136916	4247.374	0.883333
0.5	140.3514	2.89E+08	42387721	784.0867	0.146658	4089.008	1.100000
0.2	140.3151	2.74E+08	44944859	783.3923	0.163993	3895.689	1.533333
0.1	140.3329	2.64E+08	46038146	783.3923	0.174691	3767.143	2.266667
0.05	140.5092	2.54E+08	46318552	784.0867	0.182494	3669.586	3.366667
0.02	141.1793	2.44E+08	45317177	784.7812	0.185941	3521.654	5.950000
0.01	141.3929	2.37E+08	44446276	786.8645	0.187214	3475.735	11.03333

ตารางที่ C.35 DMA data of sPS1 blended with PEMA for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.7173	3.15E+08	31725615	805.6144	0.100788	4326.937	0.133333
50	159.6841	3.06E+08	31563005	811.1699	0.103019	4372.605	0.233333
20	159.6565	2.96E+08	31557141	813.9477	0.106525	4395.87	0.333333
10	159.6341	2.87E+08	32765201	814.6421	0.114143	4247.353	0.450000
5	159.6154	2.76E+08	34757422	815.3365	0.125799	4137.473	0.566667
2	159.5879	2.62E+08	38071112	816.031	0.145078	3984.933	0.716667
1	159.5692	2.51E+08	40601833	816.7255	0.162059	3872.043	0.900000
0.5	159.579	2.41E+08	41472365	817.4199	0.172384	3666.17	1.116667
0.2	159.6341	2.28E+08	42049328	818.1143	0.184218	3507.763	1.533333
0.1	159.8504	2.2E+08	41547268	819.5032	0.188469	3397.856	2.283333
0.05	160.2778	2.14E+08	40431380	821.5865	0.188777	3293.325	3.383333
0.02	161.1436	2.07E+08	38363471	822.9754	0.185125	3091.543	5.966667
0.01	161.3464	2.04E+08	36706552	825.0587	0.179962	3030.753	11.05000

ตารางที่ C.36 DMA data of sPS1 blended with PEMA for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	178.9824	2.71E+08	27516586	839.642	0.101508	3573.835	0.133333
50	178.9904	2.63E+08	28838107	845.8919	0.109552	3697.583	0.233333
20	178.9987	2.52E+08	31362948	849.3641	0.124507	3826.134	0.333333
10	179.0069	2.42E+08	33265003	850.753	0.137725	3466.988	0.450000
5	179.0187	2.31E+08	34910943	850.753	0.150947	3376.3	0.566667
2	179.0483	2.17E+08	36133680	851.4474	0.166153	3246.614	0.716667
1	179.1018	2.08E+08	36499651	852.1419	0.175499	3141.782	0.900000
0.5	179.1658	2.01E+08	35558849	852.1419	0.176701	2948.293	1.116667
0.2	179.3106	1.94E+08	34055581	852.1419	0.175916	2822.615	1.533333
0.1	179.655	1.89E+08	32745469	852.8363	0.17328	2743.836	2.283333
0.05	180.177	1.85E+08	31460435	854.2252	0.169948	2678.403	3.366667
0.02	180.9918	1.81E+08	29697799	854.2252	0.164024	2607.981	5.950000
0.01	180.8126	1.79E+08	28720328	855.6141	0.160451	2569.294	11.03333

ตารางที่ C.37 DMA data of sPS1 blended with PHMA for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.52285	2.81E+09	1.06E+08	93.11896	0.033701	9806.65	0.133333
50	60.54353	2.85E+09	1.45E+08	93.11896	0.040512	9806.65	0.233333
20	60.5639	2.85E+09	1.3E+08	93.11896	0.035004	9806.65	0.333333
10	60.59384	2.84E+09	1.27E+08	93.11896	0.034282	9806.65	0.450000
5	60.6105	2.8E+09	1.31E+08	93.11896	0.036112	9806.65	0.566667
2	60.6392	2.74E+09	1.34E+08	93.11896	0.037717	9806.65	0.700000
1	60.67531	2.69E+09	1.38E+08	93.11896	0.039512	9806.65	0.883333
0.5	60.70895	2.64E+09	1.44E+08	93.11896	0.041962	9806.65	1.100000
0.2	60.78548	2.56E+09	1.5E+08	93.11896	0.045104	9806.65	1.516667
0.1	60.84443	2.51E+09	1.71E+08	93.8134	0.052521	9806.65	2.266667
0.05	60.81357	2.47E+09	1.8E+08	94.50784	0.056323	9806.65	3.350000
0.02	60.10005	2.39E+09	1.95E+08	95.20228	0.062865	9806.65	5.933333
0.01	57.69687	2.33E+09	1.07E+08	96.59116	0.032413	9806.65	11.01667

ตารางที่ C.38 DMA data of sPS1 blended with PHMA for temperature 70 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	72.12812	2.54E+09	1.22E+08	101.4522	0.041274	9806.65	0.133333
50	72.12812	2.53E+09	1.69E+08	101.4522	0.051604	9806.65	0.233333
20	72.12351	2.56E+09	1.58E+08	101.4522	0.04755	9806.65	0.333333
10	72.10694	2.52E+09	1.56E+08	101.4522	0.047487	9806.65	0.450000
5	72.1097	2.46E+09	1.63E+08	101.4522	0.050962	9806.65	0.566667
2	72.0919	2.42E+09	1.73E+08	101.4522	0.056406	9806.65	0.700000
1	72.06981	2.36E+09	1.78E+08	101.4522	0.060143	9806.65	0.883333
0.5	72.05201	2.27E+09	1.84E+08	101.4522	0.064239	9806.65	1.100000
0.2	71.96423	2.17E+09	1.97E+08	102.1467	0.072269	9806.65	1.516667
0.1	71.75033	2.11E+09	2.07E+08	102.1467	0.078778	9806.65	2.266667
0.05	71.24793	2.03E+09	2.15E+08	102.8411	0.08418	9806.65	3.350000
0.02	69.66698	1.89E+09	2.29E+08	104.23	0.093339	9806.65	5.933333
0.01	67.32368	1.82E+09	1.8E+08	104.9244	0.067839	9806.65	11.01667

ตารางที่ C.39 DMA data of sPS1 blended with PHMA for temperature 79.22 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	80.25379	2.27E+09	1.68E+08	109.0911	0.061527	6200	0.133333
50	80.26729	2.26E+09	2.06E+08	110.48	0.070482	6200	0.233333
20	80.28969	2.21E+09	2.06E+08	110.48	0.071843	6200	0.333333
10	80.30687	2.13E+09	2.11E+08	110.48	0.076296	6200	0.450000
5	80.33511	2.03E+09	2.13E+08	110.48	0.080942	6200	0.566667
2	80.35259	1.89E+09	2.15E+08	110.48	0.087711	6200	0.700000
1	80.38113	1.78E+09	2.16E+08	110.48	0.093349	6200	0.883333
0.5	80.38727	1.69E+09	2.2E+08	110.48	0.100591	6200	1.100000
0.2	80.398	1.56E+09	2.24E+08	110.48	0.110689	6200	1.516667
0.1	80.35382	1.38E+09	2.31E+08	110.48	0.120268	6200	2.266667
0.05	80.12522	1.28E+09	2.4E+08	110.48	0.13116	6200	3.350000
0.02	79.27679	1.11E+09	2.51E+08	110.48	0.142853	6200	5.916667
0.01	78.60049	9.28E+08	2.42E+08	110.48	0.136571	6200	11.00000

ตารางที่ C.40 DMA data of sPS1 blended with PHMA for temperature 90 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	92.28544	1.62E+09	2.35E+08	120.2021	0.120547	6200	0.133333
50	92.11644	1.55E+09	2.68E+08	120.8966	0.134437	6200	0.233333
20	91.94622	1.45E+09	2.62E+08	121.591	0.139249	6200	0.350000
10	91.77385	1.36E+09	2.59E+08	122.2854	0.146631	6200	0.450000
5	91.59166	1.26E+09	2.54E+08	122.2854	0.154697	6200	0.566667
2	91.38004	1.14E+09	2.46E+08	122.9799	0.16578	6200	0.716667
1	91.11473	1.05E+09	2.37E+08	122.9799	0.174111	6200	0.900000
0.5	90.79422	9.71E+08	2.3E+08	122.9799	0.182333	6200	1.116667
0.2	90.18141	8.71E+08	2.21E+08	123.6743	0.195742	6200	1.533333
0.1	89.21651	8.07E+08	2.17E+08	123.6743	0.206893	6200	2.283333
0.05	88.18535	7.48E+08	2.11E+08	124.3688	0.217225	6200	3.366667
0.02	87.49403	6.65E+08	1.96E+08	125.0632	0.227141	6200	5.950000
0.01	89.83667	5.57E+08	1.79E+08	126.4521	0.247596	6200	11.03333

ตารางที่ C.41 DMA data of sPS1 blended with PHMA for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	99.59861	1.4E+09	2.22E+08	125.0632	0.121577	6200	0.133333
50	99.65566	1.3E+09	2.58E+08	125.7576	0.141808	6200	0.233333
20	99.70136	1.18E+09	2.47E+08	126.4521	0.147366	6200	0.350000
10	99.7578	1.07E+09	2.36E+08	127.1465	0.15468	6200	0.450000
5	99.80318	9.87E+08	2.26E+08	127.841	0.162143	6200	0.566667
2	99.86514	8.82E+08	2.11E+08	127.841	0.172558	6200	0.716667
1	99.9455	7.79E+08	1.99E+08	128.5354	0.181175	6200	0.900000
0.5	100.0295	7.15E+08	1.86E+08	129.2298	0.188944	6200	1.116667
0.2	100.1666	6.32E+08	1.68E+08	129.9243	0.197441	6200	1.533333
0.1	100.3902	5.64E+08	1.52E+08	131.3132	0.202893	6200	2.283333
0.05	100.6193	4.98E+08	1.35E+08	133.3965	0.204043	6200	3.366667
0.02	100.6905	4.35E+08	1.12E+08	135.4798	0.198938	6032.912	5.950000
0.01	100.2286	3.91E+08	92373125	138.2576	0.181749	5889.426	11.05000

ตารางที่ C.42 DMA data of sPS1 blended with PHMA for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	119.1145	7.23E+08	1.88E+08	177.8406	0.200144	9806.65	0.133333
50	119.1231	6.07E+08	1.88E+08	178.5351	0.217132	9806.65	0.233333
20	119.1225	5.23E+08	1.67E+08	179.924	0.221569	9806.65	0.350000
10	119.132	4.74E+08	1.5E+08	180.6184	0.223527	9806.65	0.450000
5	119.1385	4.24E+08	1.32E+08	181.3128	0.221201	9806.65	0.583333
2	119.1345	3.83E+08	1.09E+08	182.0073	0.210543	9806.65	0.716667
1	119.1524	3.51E+08	91202305	182.7017	0.196059	9806.65	0.900000
0.5	119.1817	3.27E+08	75115664	184.0906	0.177011	9806.65	1.116667
0.2	119.286	2.97E+08	57337273	185.4795	0.148885	9806.65	1.533333
0.1	119.5394	2.76E+08	46562496	186.8684	0.129738	9806.65	2.300000
0.05	120.0681	2.62E+08	38479211	190.3406	0.113074	9611.993	3.383333
0.02	121.0853	2.49E+08	31711475	190.3406	0.098135	8254.192	5.966667
0.01	121.1238	2.41E+08	27937373	192.4239	0.089242	7552.869	11.05000

ตารางที่ C.43 DMA data of sPS1 blended with PHMA for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	139.5047	3.53E+08	99239141	220.8959	0.216582	9806.65	0.133333
50	139.4841	3.26E+08	85428797	224.3681	0.201819	9806.65	0.233333
20	139.4694	2.96E+08	63867059	224.3681	0.165981	9127.108	0.333333
10	139.4553	2.8E+08	50692246	222.2848	0.139272	8359.732	0.450000
5	139.4325	2.68E+08	40866055	220.2015	0.117202	7682.435	0.566667
2	139.4178	2.57E+08	32541064	218.1182	0.097571	6950.035	0.716667
1	139.4003	2.5E+08	28453141	216.7293	0.087755	6524.73	0.900000
0.5	139.3875	2.43E+08	25940246	215.3404	0.082124	6194.39	1.116667
0.2	139.4253	2.35E+08	24111898	214.646	0.078977	5875.273	1.533333
0.1	139.5622	2.29E+08	23136861	214.646	0.077846	5744.742	2.283333
0.05	139.9374	2.23E+08	22840684	214.646	0.079034	5487.676	3.366667
0.02	141.019	2.14E+08	22568658	215.3404	0.081255	5249.987	5.950000
0.01	141.3499	2.08E+08	21625898	218.1182	0.080187	5107.258	11.03333

ตารางที่ C.44 DMA data of sPS1 blended with PHMA for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.8261	2.47E+08	36309625	246.5902	0.112981	6192.858	0.133333
50	159.8087	2.43E+08	31332885	249.368	0.099243	6156.934	0.233333
20	159.8068	2.35E+08	25567219	249.368	0.083668	5802.035	0.333333
10	159.7919	2.3E+08	23172473	248.6735	0.077722	5597.144	0.450000
5	159.7821	2.24E+08	21608916	248.6735	0.074281	5425.007	0.566667
2	159.7748	2.17E+08	20471713	247.9791	0.072631	5242.914	0.716667
1	159.772	2.12E+08	19897029	247.9791	0.072345	5125.323	0.883333
0.5	159.7761	2.07E+08	19855914	247.2846	0.074037	5019.155	1.116667
0.2	159.7922	1.99E+08	19363373	247.2846	0.074935	4907.201	1.533333
0.1	159.934	1.94E+08	19174879	247.2846	0.076246	4792.051	2.283333
0.05	160.2845	1.88E+08	19074619	247.9791	0.077939	4678.815	3.366667
0.02	161.1471	1.81E+08	18874912	249.368	0.080219	4528.5	5.950000
0.01	161.6852	1.76E+08	18697541	251.4513	0.08193	4428.071	11.03333

ตารางที่ C.45 DMA data of sPS1 blended with PHMA for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	180.0961	2.05E+08	24026281	278.5345	0.090283	4512.982	0.133333
50	180.027	2.01E+08	20942902	281.3122	0.080404	4671.375	0.233333
20	179.9456	1.94E+08	19397414	283.3955	0.077097	4798.578	0.350000
10	179.8568	1.89E+08	18653463	283.3955	0.076042	4661.766	0.450000
5	179.767	1.84E+08	18141418	283.3955	0.075883	4566.053	0.566667
2	179.6652	1.78E+08	17620604	283.3955	0.07624	4443.001	0.700000
1	179.5394	1.73E+08	17297203	283.3955	0.076834	4349.539	0.883333
0.5	179.422	1.69E+08	16980066	283.3955	0.077431	4250.541	1.100000
0.2	179.2574	1.63E+08	16705322	282.7011	0.078814	4120.921	1.516667
0.1	179.1511	1.59E+08	16317265	282.7011	0.079088	4026.346	2.266667
0.05	179.3946	1.54E+08	15892819	282.7011	0.079272	3930.483	3.35000
0.02	180.5519	1.48E+08	16031247	283.3955	0.083364	3804.941	5.95000
0.01	181.1012	1.43E+08	14709004	286.1733	0.078961	3732.179	11.03333

ตารางที่ C.46 DMA data of sPS1 blended with PaMS for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	55.30696	2.6E+09	1.66E+08	1969.496	0.063762	9806.65	0.133333
50	55.2474	2.68E+09	1.21E+08	1969.496	0.045294	9806.65	0.233333
20	56.17641	2.71E+09	1.08E+08	1969.496	0.039656	9806.65	0.333333
10	56.11099	2.7E+09	1.02E+08	1969.496	0.037714	9806.65	0.450000
5	56.04742	2.68E+09	1E+08	1969.496	0.03748	9806.65	0.566667
2	58.97736	2.65E+09	99503438	1969.496	0.037614	9806.65	0.716667
1	59.89002	2.62E+09	99886626	1969.496	0.038107	9806.65	0.900000
0.5	59.80453	2.6E+09	98774773	1969.496	0.037932	9806.65	1.116667
0.2	60.67091	2.58E+09	99323374	1969.496	0.038527	9806.65	1.533333
0.1	60.50888	2.56E+09	1.01E+08	1969.496	0.039569	9806.65	2.283333
0.05	62.57678	2.55E+09	1.08E+08	1970.19	0.042373	9806.65	3.383333
0.02	63.86017	2.53E+09	1.17E+08	1970.885	0.046361	9806.65	5.966667
0.01	64.2746	2.55E+09	37202869	1979.218	0.01461	9806.65	11.05000

ตารางที่ C.47 DMA data of sPS1 blended with PaMS for temperature 70 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	72.01549	2.46E+09	1.48E+08	1977.829	0.060279	9806.65	0.116667
50	71.9492	2.54E+09	1.19E+08	1977.829	0.046714	9806.65	0.233333
20	71.88014	2.57E+09	1.09E+08	1977.829	0.042427	9806.65	0.333333
10	71.816	2.56E+09	1.04E+08	1977.829	0.040692	9806.65	0.433333
5	71.73406	2.53E+09	1.01E+08	1977.829	0.040015	9806.65	0.550000
2	71.62695	2.51E+09	1.01E+08	1977.829	0.040404	9806.65	0.700000
1	71.47411	2.48E+09	1.01E+08	1977.829	0.040824	9806.65	0.883333
0.5	71.27463	2.47E+09	1.02E+08	1977.829	0.04149	9806.65	1.100000
0.2	70.87198	2.44E+09	1.05E+08	1977.829	0.042936	9806.65	1.500000
0.1	70.07717	2.42E+09	1.07E+08	1977.829	0.044401	9806.65	2.250000
0.05	68.86594	2.4E+09	1.13E+08	1977.829	0.046803	9806.65	3.333333
0.02	70.37849	2.43E+09	1.07E+08	1977.829	0.044079	9806.65	5.916667
0.01	69.9747	2.42E+09	74244510	1982.69	0.030713	9806.65	11.00000

ตารางที่ C.48 DMA data of sPS1 blended with PaMS for temperature 80 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	79.95246	2.2E+09	1E+08	1924.357	0.045554	9806.65	0.133333
50	80.08379	2.3E+09	1.01E+08	1924.357	0.044056	9806.65	0.233333
20	80.21359	2.31E+09	93660838	1924.357	0.040611	9806.65	0.333333
10	80.36272	2.29E+09	93430192	1925.052	0.040815	9806.65	0.450000
5	80.50264	2.26E+09	94607216	1925.746	0.0418	9806.65	0.566667
2	80.68184	2.23E+09	99863679	1926.441	0.044855	9806.65	0.716667
1	80.87454	2.2E+09	1.04E+08	1926.441	0.047517	9806.65	0.883333
0.5	81.08688	2.16E+09	1.11E+08	1927.135	0.051235	9806.65	1.116667
0.2	81.38912	2.11E+09	1.25E+08	1927.829	0.059078	9806.65	1.533333
0.1	81.63215	2.07E+09	1.37E+08	1928.524	0.066202	9806.65	2.283333
0.05	81.58919	2.01E+09	1.56E+08	1929.913	0.077358	9806.65	3.366667
0.02	80.04145	1.94E+09	1.74E+08	1931.996	0.088033	9806.65	5.950000
0.01	77.2875	1.84E+09	1.51E+08	1933.385	0.073652	9806.65	11.03333

ตารางที่ C.49 DMA data of sPS1 blended with PaMS for temperature 90.24 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	89.76276	2.1E+09	1.14E+08	1940.329	0.054432	9806.65	0.133333
50	89.92531	2.18E+09	1.2E+08	1943.107	0.055085	9806.65	0.233333
20	90.09584	2.16E+09	1.22E+08	1945.19	0.056722	9806.65	0.333333
10	90.26913	2.11E+09	1.28E+08	1946.579	0.060547	9806.65	0.450000
5	90.46358	2.05E+09	1.38E+08	1947.968	0.06741	9806.65	0.566667
2	90.68503	1.97E+09	1.57E+08	1948.663	0.079633	9806.65	0.716667
1	90.9718	1.89E+09	1.74E+08	1950.052	0.092464	9806.65	0.900000
0.5	91.25766	1.8E+09	1.95E+08	1951.44	0.108559	9806.65	1.116667
0.2	91.74502	1.66E+09	2.26E+08	1953.524	0.136221	9806.65	1.533333
0.1	92.5489	1.54E+09	2.47E+08	1955.607	0.159908	9806.65	2.283333
0.05	94.02877	1.4E+09	2.62E+08	1963.94	0.178842	9806.65	3.383333
0.02	86.13071	1.2E+09	3.05E+08	1968.801	0.18656	9806.65	5.966667
0.01	92.71667	1.07E+09	2.99E+08	1964.635	0.223376	9806.65	11.05000

ตารางที่ C.50 DMA data of sPS1 blended with PaMS for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	99.63081	1.79E+09	1.7E+08	1977.829	0.094944	9806.65	0.133333
50	99.76914	1.8E+09	1.95E+08	1981.996	0.108754	9806.65	0.233333
20	99.91391	1.69E+09	2.17E+08	1986.162	0.128488	9806.65	0.333333
10	100.063	1.58E+09	2.35E+08	1989.635	0.14861	9806.65	0.450000
5	100.2209	1.45E+09	2.52E+08	1991.718	0.173637	9806.65	0.566667
2	100.3755	1.27E+09	2.69E+08	1994.496	0.211714	9806.65	0.716667
1	100.5733	1.12E+09	2.72E+08	1997.273	0.243688	9806.65	0.900000
0.5	100.777	9.68E+08	2.66E+08	2000.051	0.274874	9806.65	1.116667
0.2	101.1184	7.81E+08	2.43E+08	2003.523	0.311906	9806.65	1.533333
0.1	101.4784	6.5E+08	2.18E+08	2008.385	0.335367	9806.65	2.283333
0.05	100.9469	5.16E+08	2.08E+08	2018.107	0.340775	9806.65	3.383333
0.02	99.06187	4.27E+08	1.76E+08	2025.745	0.340885	9806.65	5.966667
0.01	99.45415	3.34E+08	1.37E+08	2032.69	0.333406	8384.123	11.05000

ตารางที่ C.51 DMA data of sPS1 blended with PaMS for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	119.6129	7.24E+08	2.31E+08	2076.44	0.357528	9806.65	0.133333
50	119.666	5.72E+08	2.11E+08	2097.967	0.367997	9806.65	0.233333
20	119.7089	4.56E+08	1.71E+08	2110.467	0.37417	9806.65	0.333333
10	119.7589	3.85E+08	1.4E+08	2118.801	0.364754	9806.65	0.450000
5	119.8079	3.29E+08	1.13E+08	2126.439	0.343586	9806.65	0.566667
2	119.8804	2.74E+08	83591932	2131.995	0.304537	9714.622	0.716667
1	119.9786	2.43E+08	65645192	2131.3	0.269828	8915.535	0.900000
0.5	120.1082	2.19E+08	51469950	2125.05	0.234874	7985.162	1.116667
0.2	120.3792	1.96E+08	36767543	2113.245	0.187977	6787.148	1.533333
0.1	120.7686	1.81E+08	27819790	2103.523	0.153593	5856.619	2.283333
0.05	121.1075	1.7E+08	21888141	2102.134	0.128403	5633.82	3.383333
0.02	119.9332	1.61E+08	17319073	2095.884	0.107683	4851.828	5.966667
0.01	120.7081	1.61E+08	14280587	2083.384	0.088699	3933.281	11.05000

ตารางที่ C.52 DMA data of sPS1 blended with PaMS for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	138.6777	2.21E+08	56593107	2098.662	0.255605	4207.258	0.15
50	138.7024	2.03E+08	43175114	2114.634	0.213198	5213.479	0.283333
20	138.7421	1.87E+08	31117543	2108.384	0.166162	4287.301	0.416667
10	138.7896	1.79E+08	24734638	2101.439	0.138567	3690.847	0.566667
5	138.833	1.69E+08	20596385	2094.495	0.121604	3170.167	0.683333
2	138.8908	1.65E+08	16894476	2088.939	0.102557	2721.08	0.816667
1	138.9836	1.62E+08	15148256	2085.467	0.093353	2444.697	1.000000
0.5	139.0845	1.6E+08	14074954	2083.384	0.087946	2236.073	1.216667
0.2	139.3347	1.57E+08	13442651	2080.606	0.085594	2023.441	1.650000
0.1	139.8177	1.55E+08	13240970	2078.523	0.085437	1849.678	2.40000
0.05	140.5157	1.51E+08	13076266	2079.217	0.086434	1839.152	3.483333
0.02	140.8297	1.46E+08	12426098	2079.217	0.084875	1756.785	6.066667
0.01	138.0791	1.43E+08	13274077	2078.523	0.092933	1811.542	11.15000

ตารางที่ C.53 DMA data of sPS1 blended with PaMS for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	158.2346	1.73E+08	19698269	2100.051	0.113904	2015.078	0.133333
50	158.2767	1.67E+08	16225140	2104.912	0.097255	2126.519	0.233333
20	158.3162	1.65E+08	13440577	2104.912	0.081478	1981.803	0.333333
10	158.3618	1.62E+08	12243358	2104.217	0.075576	1923.302	0.450000
5	158.4035	1.61E+08	11630519	2102.134	0.072375	1745.168	0.566667
2	158.4599	1.57E+08	11345487	2102.134	0.072445	1702.764	0.716667
1	158.5475	1.53E+08	11302891	2102.134	0.073747	1680.569	0.883333
0.5	158.6664	1.5E+08	11405324	2102.134	0.076141	1660.672	1.100000
0.2	158.9087	1.45E+08	11664917	2102.134	0.080488	1634.535	1.516667
0.1	159.4032	1.41E+08	11838608	2102.828	0.084044	1617.135	2.283333
0.05	160.1298	1.37E+08	12107980	2104.217	0.088614	1585.957	3.366667
0.02	161.1477	1.31E+08	12392369	2106.301	0.094618	1577.803	5.95000
0.01	160.9402	1.28E+08	12555312	2106.995	0.098343	1486.476	11.03333

ตารางที่ C.54 DMA data of sPS1 blended with PaMS for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	179.4153	1.53E+08	11110538	2128.523	0.072814	1458.113	0.133333
50	179.5127	1.45E+08	12260625	2134.078	0.084461	1650.223	0.233333
20	179.6111	1.44E+08	10136020	2136.161	0.070486	1704.916	0.35000
10	179.7104	1.41E+08	9991551	2137.55	0.071077	1713.407	0.45000
5	179.7998	1.38E+08	9984397	2137.55	0.072547	1686.378	0.566667
2	179.9153	1.34E+08	10023461	2137.55	0.075077	1664.823	0.716667
1	180.0465	1.3E+08	10131908	2137.55	0.077699	1635.087	0.900000
0.5	180.2148	1.27E+08	10278509	2137.55	0.080731	1604.814	1.116667
0.2	180.4886	1.23E+08	10533049	2137.55	0.085556	1562.037	1.533333
0.1	180.832	1.2E+08	10728351	2137.55	0.089511	1525.526	2.283333
0.05	181.0491	1.17E+08	10863055	2137.55	0.093042	1489.526	3.350000
0.02	180.7079	1.13E+08	10900380	2137.55	0.096385	1443.013	5.933333
0.01	180.2037	1.1E+08	10801473	2136.856	0.097955	1410.854	11.03333

ตารางที่ C.55 DMA data of sPS2 for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.42996	3108875964	1.55E+08	120.2021	0.055825	9806.65	0.133333
50	60.53026	3101962918	1.85E+08	122.2854	0.060961	9806.65	0.233333
20	60.63087	3076428889	1.85E+08	122.9799	0.059548	9806.65	0.333333
10	60.73827	3064791793	1.8E+08	122.9799	0.058005	9806.65	0.450000
5	60.84813	3043721057	1.8E+08	122.9799	0.058506	9806.65	0.566667
2	60.96819	3014616471	1.87E+08	123.6743	0.061375	9806.65	0.700000
1	61.11755	2991088414	1.87E+08	123.6743	0.061821	9806.65	0.883333
0.5	61.29161	2964772800	1.89E+08	123.6743	0.063049	9806.65	1.100000
0.2	61.57276	2936464811	1.97E+08	124.3688	0.06635	9806.65	1.516667
0.1	61.93168	2911415513	2E+08	125.0632	0.068024	9806.65	2.283333
0.05	62.20758	2897793820	2.06E+08	125.7576	0.070349	9806.65	3.366667
0.02	62.02488	2846049894	2.13E+08	127.1465	0.07296	9806.65	5.950000
0.01	60.01889	2762119790	1.27E+08	129.2298	0.041047	9806.65	11.03333

ตารางที่ C.56 DMA data of sPS2 for temperature 80°C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	80.83894	2909957152	1.52E+08	140.3409	0.056016	9806.65	0.133333
50	80.89449	2819957152	1.9E+08	141.0353	0.064352	9806.65	0.233333
20	80.97457	2794103629	1.87E+08	141.0353	0.062331	9806.65	0.333333
10	80.97028	2762119790	1.87E+08	141.7298	0.062777	9806.65	0.450000
5	81.01354	2686844357	1.89E+08	141.7298	0.063947	9806.65	0.566667
2	81.07767	2610311625	1.93E+08	141.7298	0.066624	9806.65	0.700000
1	81.02029	2576879196	1.99E+08	141.7298	0.069519	9806.65	0.883333
0.5	81.0209	2543105732	2.1E+08	142.4242	0.07447	9806.65	1.100000
0.2	80.9356	2487730821	2.21E+08	142.4242	0.08007	9806.65	1.516667
0.1	80.69626	2446784196	2.32E+08	143.1186	0.085496	9806.65	2.283333
0.05	80.18874	2392005857	2.5E+08	144.5075	0.093916	9806.65	3.366667
0.02	78.9951	2350120339	2.58E+08	145.8964	0.098849	9806.65	5.950000
0.01	78.4526	2326368197	2.26E+08	147.9797	0.08532	9806.65	11.03333

ตารางที่ C.57 DMA data of sPS2 for temperature 90°C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	91.10522	2536153550	1.96E+08	155.6186	0.079947	9806.65	0.133333
50	91.12608	2518585887	2.35E+08	158.3963	0.088796	9806.65	0.233333
20	91.13589	2499297996	2.32E+08	159.0908	0.087395	9806.65	0.333333
10	91.14264	2460367604	2.33E+08	159.7852	0.089166	9806.65	0.450000
5	91.1451	2387811283	2.37E+08	159.7852	0.092417	9806.65	0.566667
2	91.15061	2322736796	2.49E+08	160.4796	0.100069	9806.65	0.716667
1	91.15154	2296148648	2.58E+08	161.1741	0.106784	9806.65	0.900000
0.5	91.13866	2213094710	2.7E+08	161.8685	0.115077	9806.65	1.116667
0.2	91.0586	2147830474	2.9E+08	163.2574	0.129844	9806.65	1.533333
0.1	90.84145	2065380156	3.11E+08	164.6463	0.14542	9806.65	2.283333
0.05	90.46328	2029037500	3.37E+08	166.7296	0.165898	9806.65	3.366667
0.02	89.62106	1786487575	3.59E+08	169.5074	0.188057	9806.65	5.950000
0.01	89.42139	1531087462	3.56E+08	174.3684	0.191497	9806.65	11.05000

ตารางที่ C.58 DMA data of sPS2 for temperature 100.25 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	99.406	2187761624	2.03E+08	176.4518	0.098616	9806.65	0.133333
50	99.51059	2108628150	2.49E+08	179.924	0.116961	9806.65	0.233333
20	99.62223	2027682720	2.61E+08	183.3962	0.127011	9806.65	0.333333
10	99.74461	1950020000	2.7E+08	186.1739	0.13832	9806.65	0.450000
5	99.87281	1833053036	2.81E+08	187.5628	0.153414	9806.65	0.566667
2	100.0179	1663024107	2.96E+08	189.6461	0.177806	9806.65	0.716667
1	100.1792	1521158214	3.05E+08	191.7294	0.200328	9806.65	0.900000
0.5	100.3859	1373311339	3.09E+08	195.2016	0.224934	9806.65	1.116667
0.2	100.7632	1173890625	3.08E+08	197.9794	0.262013	9806.65	1.533333
0.1	101.2993	990831945	2.99E+08	202.8405	0.292867	9806.65	2.283333
0.05	101.7526	831763771	2.88E+08	210.4793	0.328806	9806.65	3.383333
0.02	101.6134	647142616	2.7E+08	219.507	0.361723	9806.65	5.966667
0.01	100.0734	517606832	2.66E+08	233.3958	0.355373	9806.65	11.05000

ตารางที่ C.59 DMA data of sPS2 for temperature 110 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	109.3462	1753880502	2.62E+08	368.1172	0.165708	9806.65	0.133333
50	109.3391	1472312502	3.05E+08	372.2838	0.198425	9806.65	0.233333
20	109.3366	1312199899	3.14E+08	374.3672	0.227909	9806.65	0.333333
10	109.3379	1177605974	3.11E+08	375.756	0.252747	9806.65	0.450000
5	109.3477	1049542429	3.03E+08	377.1449	0.27725	9806.65	0.566667
2	109.3597	921631875	2.81E+08	378.5338	0.305176	9806.65	0.716667
1	109.3667	805332143	2.59E+08	377.1449	0.321381	8873.134	0.900000
0.5	109.3892	701541205	2.32E+08	374.3672	0.33135	8071.686	1.116667
0.2	109.5047	592888438	2E+08	368.1172	0.33698	6394.382	1.533333
0.1	109.7051	465091786	1.78E+08	375.756	0.383329	9806.65	2.300000
0.05	110.1088	409937321	1.44E+08	393.117	0.350593	9164.952	3.383333
0.02	110.7794	346842500	1.09E+08	397.9781	0.315497	7997.814	5.966667
0.01	110.7093	310455959	93267578	401.4503	0.273823	7883.295	11.05000

ตารางที่ C.60 DMA data of sPS2 for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	119.1033	1111731727	3.04E+08	414.6447	0.330896	9806.65	0.133333
50	119.3308	799259821	2.86E+08	419.5058	0.357225	9806.65	0.233333
20	119.5724	642140223	2.34E+08	423.6724	0.36503	9806.65	0.333333
10	119.8298	543885804	1.95E+08	426.4502	0.359233	9806.65	0.450000
5	120.0928	469068259	1.63E+08	429.9224	0.346705	9806.65	0.566667
2	120.4171	397943348	1.28E+08	429.9224	0.32142	9333.693	0.716667
1	120.8378	357671451	1.07E+08	427.1446	0.297825	8405.752	0.900000
0.5	121.2899	327879598	89461797	422.978	0.27285	7527.023	1.116667
0.2	122.0394	300083013	72638259	419.5058	0.242061	6775.671	1.533333
0.1	122.7564	290550826	65019905	413.2558	0.223782	5491.895	2.283333
0.05	122.721	283274978	59346066	409.7836	0.2095	5025.253	3.366667
0.02	119.9505	273526873	57073711	404.2281	0.201074	4243.777	5.950000
0.01	118.267	268534445	62837288	397.9781	0.214077	4113.61	11.05000

ตารางที่ C.61 DMA data of sPS2 for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	140.75	322106879	1.39E+08	459.7833	0.328776	9806.65	0.130000
50	140.6073	301300602	1.14E+08	520.1996	0.296963	8265.301	0.283333
20	140.5016	298538262	80992227	518.8107	0.263401	7132.285	0.400000
10	140.3982	294091875	69448326	513.9496	0.236145	6197.861	0.500000
5	140.2854	285104799	60987254	508.3941	0.213912	5445.42	0.633333
2	140.1646	277021250	53167266	502.8386	0.191925	4646.088	0.766667
1	140.0343	272961696	48938644	500.7552	0.179288	4290.987	0.950000
0.5	139.8924	269394866	45834079	498.6719	0.170137	4038.714	1.166667
0.2	139.685	264202656	42841381	496.5886	0.162153	3727.963	1.600000
0.1	139.52	258853973	40877874	495.1997	0.157919	3514.341	2.350000
0.05	139.6672	253142344	39110257	494.5053	0.154499	3435.523	3.433333
0.02	140.8272	243125022	37114729	495.1997	0.152657	3447.958	6.016667
0.01	141.6793	236342679	35323253	497.2831	0.149458	3427.501	11.10000

ตารางที่ C.62 DMA data of sPS2 for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.5161	278567522	56875558	521.5884	0.204172	4114.84	0.133333
50	159.4974	268786071	50083845	525.7551	0.186333	4420.147	0.233333
20	159.487	260615355	45061850	523.6718	0.166923	3633.831	0.333333
10	159.4826	258226019	41532762	523.6718	0.15712	3489.012	0.450000
5	159.4689	250610925	38923549	522.9773	0.150515	3379.584	0.566667
2	159.4623	246036760	36399258	521.5884	0.144972	3284.185	0.716667
1	159.4582	243781082	35045307	520.894	0.142893	3235.819	0.900000
0.5	159.4718	239946629	33971540	520.894	0.14158	3195.042	1.116667
0.2	159.5455	232880536	33060084	520.894	0.141962	3135.065	1.533333
0.1	159.7771	227406652	32549389	520.894	0.143133	3078.565	2.283333
0.05	160.3657	221603705	32180285	521.5884	0.145215	3019.789	3.366667
0.02	161.4603	214491384	31919654	523.6718	0.148816	2917.709	5.950000
0.01	161.3306	209880848	31977600	526.4495	0.152361	2856.769	11.03333

ตารางที่ C.63 DMA data of sPS2 for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	179.4777	238781128	16723697	724.3649	0.05004	3723.911	0.133333
50	179.5366	231206921	15413254	727.8371	0.046665	3986.767	0.233333
20	179.5919	227685365	14522580	727.8371	0.044648	3849.994	0.333333
10	179.6489	224663856	14179599	728.5316	0.04418	3807.708	0.450000
5	179.704	221508724	14086659	728.5316	0.044516	3736.679	0.566667
2	179.7705	217211548	14380658	728.5316	0.046344	3676.599	0.700000
1	179.8523	213832803	14777162	728.5316	0.048374	3628.592	0.883333
0.5	179.9484	210397452	15197153	728.5316	0.050561	3580.442	1.100000
0.2	180.1228	205684702	15937390	728.5316	0.054239	3515.749	1.516667
0.1	180.381	201949546	16546418	728.5316	0.057353	3464.076	2.266667
0.05	180.6789	198108060	17268154	729.226	0.061016	3413.519	3.350000
0.02	180.8428	193586010	17876310	729.9204	0.06464	3310.581	5.933333
0.01	180.6324	190778034	17598663	729.9204	0.064573	3288.044	11.01667

ตารางที่ C.64 DMA data of sPS2 blended with PIP for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	61.7138	2168642201	65123872	77.14684	0.055555	6200	0.133333
50	61.69991	2159050722	64567509	82.70236	0.055325	5945.729	0.233333
20	61.68294	2126173781	63000773	84.09124	0.054817	5932.133	0.350000
10	61.66164	2108383184	62644423	84.78568	0.055229	5932.133	0.466667
5	61.63356	2097443733	62271172	84.78568	0.055722	5932.133	0.566667
2	61.61504	2076040861	63485660	85.48012	0.057969	5932.133	0.716667
1	61.57183	2054940563	63714831	85.48012	0.059086	5932.133	0.900000
0.5	61.51567	2043780653	64634306	86.17456	0.060889	5932.133	1.116667
0.2	61.39006	2031489910	65690738	86.17456	0.063247	5932.133	1.533333
0.1	61.13823	2010836309	67753103	86.869	0.06629	5932.133	2.283333
0.05	60.7537	2000093934	69332300	87.56344	0.068956	5932.133	3.366667
0.02	59.52016	2026787382	71499271	88.25788	0.072408	5932.133	5.950000
0.01	56.98521	2015918267	66630022	88.95232	0.067509	5932.133	11.03333

ตารางที่ C.65 DMA data of sPS2 blended with PIP for temperature 65 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	65.92203	2020914368	61200495	96.59116	0.055021	7738.775	0.133333
50	65.85137	1986510542	66807378	111.1744	0.060202	7848.938	0.283333
20	65.81096	1951176292	65583537	111.1744	0.059904	7399.854	0.400000
10	65.76468	1934668688	64699219	111.1744	0.05995	7314.645	0.500000
5	65.7184	1926807458	64812917	111.1744	0.060982	7231.104	0.616667
2	65.66749	1908281208	65459440	111.1744	0.062932	7115.243	0.766667
1	65.59468	1860032521	65983247	111.1744	0.064465	7021.73	0.950000
0.5	65.49503	1831205361	66673928	111.1744	0.066237	6934.815	1.150000
0.2	65.31608	1815769963	67659475	111.1744	0.068743	6815.752	1.566667
0.1	64.95417	1760645635	68820764	111.1744	0.071067	6723.604	2.316667
0.05	64.38062	1721248039	71261801	111.1744	0.074681	6636.604	3.400000
0.02	62.93423	1652387010	70589214	111.1744	0.075348	6549.897	5.983333
0.01	61.71009	1604052754	69787079	111.1744	0.074678	6558.659	11.06667

ตารางที่ C.66 DMA data of sPS2 blended with PIP for temperature 70.71 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	72.06889	1831979333	65731962	116.7299	0.061076	7080.453	0.133333
50	72.02531	1826553025	67970486	118.8132	0.063101	7248.469	0.233333
20	71.97498	1795548756	67558403	120.2021	0.063636	7400.099	0.350000
10	71.93078	1735879147	67490234	120.2021	0.06463	7314.49	0.450000
5	71.87708	1702387010	68345911	120.8966	0.066571	7220.961	0.566667
2	71.81969	1680080154	69025807	120.8966	0.068911	7094.653	0.716667
1	71.7227	1649684836	69561602	120.8966	0.070799	7000.518	0.900000
0.5	71.59749	1593141966	70353737	120.8966	0.073035	6906.685	1.100000
0.2	71.37806	1562187899	71795208	120.8966	0.07659	6783.207	1.516667
0.1	70.93858	1484583137	73217413	121.591	0.079724	6689.724	2.266667
0.05	70.23486	1402199899	76440920	121.591	0.084895	6609.764	3.350000
0.02	68.45791	1191242008	76180877	122.2854	0.086763	6524.745	5.933333
0.01	67.25159	1042317429	76073108	122.2854	0.087001	6472.134	11.01667

ตารางที่ C.67 DMA data of sPS2 blended with PIP for temperature 85 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	86.13285	1430384265	1.76E+08	-1041.6	0.196064	7463.163	0.133333
50	86.16291	1261827535	1.54E+08	-1032.57	0.17324	7577.371	0.233333
20	86.18254	1172195366	1.51E+08	-1029.1	0.171579	7565.739	0.333333
10	86.20647	1061695557	1.48E+08	-1027.01	0.171192	7377.884	0.450000
5	86.23131	1000000000	1.48E+08	-1025.62	0.173926	7552.187	0.566667
2	86.24848	959400632	1.48E+08	-1024.23	0.179535	7479.226	0.716667
1	86.27179	933254301	1.49E+08	-1022.85	0.184387	7420.018	0.900000
0.5	86.28805	893305484	1.49E+08	-1021.46	0.189932	7362.896	1.116667
0.2	86.24449	837529282	1.5E+08	-1020.76	0.199354	7266.386	1.533333
0.1	86.15463	765596607	1.51E+08	-1019.37	0.206905	7180.866	2.300000
0.05	85.84105	717794291	1.52E+08	-1017.29	0.215893	7106.901	3.383333
0.02	84.30402	673795750	1.52E+08	-1015.9	0.225126	6780.962	5.966667
0.01	87.88937	591221375	1.38E+08	-1013.82	0.234127	6914.046	11.05000

ตารางที่ C.68 DMA data of sPS2 blended with PIP for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	99.79521	699841996	1.96E+08	-1004.1	0.320168	6563.106	0.133333
50	99.79736	644169266	1.71E+08	-986.735	0.283733	6622.348	0.233333
20	99.79981	608135001	1.64E+08	-979.096	0.283408	6591.178	0.333333
10	99.80503	555303750	1.59E+08	-974.235	0.28587	6637.148	0.450000
5	99.80625	531476500	1.53E+08	-970.763	0.288701	6530.714	0.566667
2	99.80227	496856156	1.47E+08	-968.68	0.296145	6457.583	0.716667
1	99.80227	470539844	1.42E+08	-965.902	0.30225	6467.85	0.900000
0.5	99.813	440974563	1.36E+08	-965.208	0.309341	6073.717	1.116667
0.2	99.80043	407086375	1.29E+08	-965.208	0.315812	5886.209	1.533333
0.1	99.80074	367282300	1.22E+08	-964.513	0.317781	5734.304	2.283333
0.05	99.75105	336511569	1.15E+08	-963.124	0.319626	5567.592	3.366667
0.02	99.72068	299226464	1.07E+08	-961.735	0.322343	5410.458	5.950000
0.01	101.9079	271019163	98737094	-961.735	0.322339	4925.402	11.03333

ตารางที่ C.69 DMA data of sPS2 blended with PIP for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	119.053	363915036	1.54E+08	-949.235	0.388934	5311.709	0.133333
50	119.0811	332659553	1.32E+08	-929.097	0.349528	5249.455	0.233333
20	119.1052	311171634	1.18E+08	-924.236	0.339806	5087.215	0.350000
10	119.129	301995172	1.08E+08	-923.541	0.334777	4904.956	0.450000
5	119.1567	290402265	1E+08	-926.319	0.331766	4413.234	0.566667
2	119.2006	274728906	87812797	-929.791	0.319634	4168.966	0.716667
1	119.2592	256292484	78985273	-931.874	0.308184	3982.856	0.900000
0.5	119.3376	240373094	70833055	-933.263	0.29468	3902.689	1.116667
0.2	119.495	222820969	61869277	-935.347	0.277664	3652.35	1.533333
0.1	119.8159	210641344	55076836	-936.736	0.261472	3536.18	2.283333
0.05	120.26	200282703	49118809	-938.124	0.245247	3356.29	3.383333
0.02	121.0174	189646766	42852117	-939.513	0.225958	3125.537	5.966667
0.01	120.1088	190563953	40334617	-942.291	0.211659	2809.483	11.05000

ตารางที่ C.70 DMA data of sPS2 blended with PIP for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	139.5334	252348077	78100539	-936.041	0.318765	3706.336	0.133333
50	139.5275	234963282	63053121	-924.93	0.282346	3490.638	0.233333
20	139.5334	222711188	53833984	-925.625	0.241721	3213.196	0.350000
10	139.5322	218358813	47442109	-929.097	0.217267	2887.849	0.450000
5	139.5163	211965984	42166277	-931.874	0.198929	2732.691	0.566667
2	139.5013	205495609	37113352	-935.347	0.180604	2462.215	0.716667
1	139.5028	200793641	34132441	-937.43	0.169988	2363.315	0.900000
0.5	139.5166	196695375	31850809	-938.819	0.16193	2246.708	1.116667
0.2	139.575	191469234	29963607	-940.902	0.156493	2096.015	1.533333
0.1	139.7968	187747000	28351520	-940.902	0.151009	2063.795	2.283333
0.05	140.1898	184183453	27307305	-941.597	0.148261	1972.126	3.383333
0.02	141.0559	179299172	26312359	-942.291	0.146751	1878.211	5.966667
0.01	139.7562	177326750	26617379	-942.291	0.150104	1863.242	11.05000

ตารางที่ C.71 DMA data of sPS2 blended with PIP for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.2877	2.07E+08	22441908	-936.736	0.084323	2315.056	0.133333
50	159.2918	1.95E+08	94840266	-929.097	0.45908	2099.055	0.233333
20	159.2867	1.91E+08	29254420	-927.708	0.153158	2181.016	0.350000
10	159.2829	1.87E+08	27604713	-927.708	0.147758	2110.296	0.450000
5	159.3003	1.83E+08	26337055	-927.708	0.144231	2045.611	0.566667
2	159.325	1.77E+08	25371588	-928.402	0.143273	1968.923	0.716667
1	159.3427	1.75E+08	24838986	-929.791	0.14224	1853.578	0.900000
0.5	159.3794	1.71E+08	24271592	-930.486	0.141933	1819.531	1.116667
0.2	159.4892	1.66E+08	23912225	-930.486	0.143636	1777.275	1.533333
0.1	159.7521	1.63E+08	23556479	-930.486	0.144344	1747.799	2.283333
0.05	160.2041	1.6E+08	23071605	-930.486	0.144046	1719.866	3.350000
0.02	161.0323	1.56E+08	22644176	-930.486	0.144765	1685.272	5.933333
0.01	160.1554	1.55E+08	22285246	-930.486	0.14369	1650.023	11.01667

ตารางที่ C.72 DMA data of sPS2 blended with PIP for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	179.1855	1.79E+08	22046697	-659.654	0.085993	2221.254	0.133333
50	179.2269	1.74E+08	21306006	-656.182	0.085497	2421.229	0.233333
20	179.2689	1.71E+08	19921627	-654.098	0.081774	2539.612	0.350000
10	179.3138	1.67E+08	19116389	-654.098	0.080024	2310.78	0.450000
5	179.3602	1.64E+08	18523152	-654.098	0.079188	2268.932	0.566667
2	179.4245	1.59E+08	18234164	-654.098	0.080181	2213.611	0.716667
1	179.5028	1.56E+08	18124664	-654.793	0.081442	2172.635	0.900000
0.5	179.5986	1.52E+08	18124371	-654.793	0.083223	2133.512	1.116667
0.2	179.7285	1.48E+08	18340252	-654.793	0.086824	2081.532	1.533333
0.1	179.9411	1.44E+08	18431035	-654.793	0.089347	2043.001	2.283333
0.05	180.1429	1.41E+08	18454924	-654.793	0.091673	2006.643	3.350000
0.02	180.1604	1.37E+08	18513512	-654.793	0.094719	1960.305	5.933333
0.01	180.043	1.34E+08	17745412	-654.793	0.0926	1927.375	11.01667

ตารางที่ C.73 DMA data of sPS2 blended with PBMA for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1482	2E+09	91379870	85.48012	0.047423	6200	0.133333
50	60.09882	2.02E+09	1.01E+08	89.64676	0.05037	5970.336	0.233333
20	60.0445	2E+09	96669544	90.3412	0.048249	5959.019	0.350000
10	59.98988	2.02E+09	94502676	90.3412	0.047895	5959.019	0.450000
5	59.93649	2.02E+09	93664408	90.3412	0.04824	5959.019	0.566667
2	59.86643	2.06E+09	95869668	90.3412	0.05059	5959.019	0.716667
1	59.76953	2.04E+09	1.01E+08	91.03564	0.054323	5959.019	0.900000
0.5	59.64732	2E+09	1.03E+08	91.03564	0.056467	5959.019	1.116667
0.2	59.39888	1.95E+09	1.1E+08	91.03564	0.061852	5959.019	1.533333
0.1	58.91682	1.87E+09	1.14E+08	91.03564	0.065862	5959.019	2.283333
0.05	58.16072	1.81E+09	1.22E+08	91.73008	0.071811	5959.019	3.366667
0.02	56.54018	1.73E+09	1.31E+08	92.42452	0.079305	5959.019	5.950000
0.01	56.29823	1.59E+09	1.21E+08	92.42452	0.07415	5959.019	11.03333

ตารางที่ C.74 DMA data of sPS2 blended with PBMA for temperature 80 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	80.85674	1.95E+09	1.65E+08	850.753	0.084399	6200	0.133333
50	80.79568	1.92E+09	1.44E+08	855.6141	0.074967	6000.305	0.250000
20	80.73799	1.86E+09	1.49E+08	856.3085	0.080439	5999.559	0.350000
10	80.68368	1.79E+09	1.52E+08	857.0029	0.084782	5999.559	0.466667
5	80.62016	1.72E+09	1.54E+08	857.0029	0.089866	5999.559	0.583333
2	80.54928	1.61E+09	1.6E+08	857.6974	0.099489	5999.559	0.716667
1	80.44373	1.52E+09	1.62E+08	857.6974	0.105966	5999.559	0.900000
0.5	80.32467	1.44E+09	1.62E+08	857.6974	0.112253	5999.559	1.116667
0.2	80.08226	1.31E+09	1.62E+08	858.3918	0.121541	5999.559	1.533333
0.1	79.68459	1.1E+09	1.61E+08	859.0863	0.12831	5999.559	2.300000
0.05	79.18044	9.42E+08	1.6E+08	859.7807	0.135217	5999.559	3.383333
0.02	78.52409	8.18E+08	1.55E+08	861.1696	0.142542	5999.559	5.966667
0.01	78.96503	7.26E+08	1.41E+08	862.5585	0.14172	5999.559	11.05000

ตารางที่ C.75 DMA data of sPS2 blended with PBMA for temperature 84.22 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	85.33208	1.85E+09	1.58E+08	880.6139	0.097545	9806.65	0.133333
50	85.32993	1.69E+09	1.72E+08	882.6973	0.110308	9806.65	0.233333
20	85.32472	1.55E+09	1.72E+08	884.0861	0.117163	9806.65	0.333333
10	85.31615	1.39E+09	1.71E+08	884.7806	0.123688	9806.65	0.450000
5	85.30022	1.26E+09	1.69E+08	885.475	0.130757	9806.65	0.566667
2	85.28828	1.15E+09	1.66E+08	886.1694	0.141904	9806.65	0.716667
1	85.27634	1.02E+09	1.58E+08	886.8639	0.157591	9806.65	0.900000
0.5	85.23285	9.31E+08	1.44E+08	888.9472	0.157377	9806.65	1.116667
0.2	85.16456	8.28E+08	1.35E+08	890.3361	0.163055	9806.65	1.533333
0.1	85.01022	7.7E+08	1.28E+08	892.4194	0.166444	9806.65	2.283333
0.05	84.77502	7.24E+08	1.22E+08	893.1138	0.168045	9105.187	3.383333
0.02	84.27431	6.71E+08	1.13E+08	893.1138	0.168802	8504.206	5.950000
0.01	84.2936	6.38E+08	1.04E+08	893.8083	0.162267	7942.243	11.05000

ตารางที่ C.76 DMA data of sPS2 blended with PBMA for temperature 90 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	90.59547	1.43E+09	1.48E+08	899.3638	0.116218	9806.65	0.133333
50	90.56235	1.22E+09	1.67E+08	900.0582	0.136497	9806.65	0.233333
20	90.52493	1.08E+09	1.65E+08	901.4471	0.146263	9806.65	0.350000
10	90.49641	9.84E+08	1.59E+08	902.836	0.152105	9806.65	0.450000
5	90.45807	9.23E+08	1.53E+08	903.5305	0.158112	9806.65	0.566667
2	90.41022	8.75E+08	1.44E+08	904.2249	0.164104	9756.174	0.716667
1	90.35287	8.13E+08	1.35E+08	902.1415	0.166229	8670.738	0.900000
0.5	90.29152	7.55E+08	1.26E+08	901.4471	0.167349	8101.237	1.116667
0.2	90.13909	6.85E+08	1.15E+08	899.3638	0.167235	7477.493	1.533333
0.1	89.93022	6.4E+08	1.06E+08	897.9749	0.165396	7056.695	2.283333
0.05	89.69466	6E+08	98040456	897.2805	0.163389	6704.466	3.383333
0.02	89.48273	5.52E+08	88397988	897.2805	0.160286	6294.627	5.950000
0.01	89.88882	5.13E+08	77688828	897.2805	0.151345	6018.605	11.03333

ตารางที่ C.77 DMA data of sPS2 blended with PBMA for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	100.262	9.18E+08	1.55E+08	925.7525	0.177938	9806.65	0.133333
50	100.2648	7.89E+08	1.52E+08	929.9192	0.191181	9806.65	0.241546
20	100.2682	7.28E+08	1.36E+08	932.0025	0.192072	9706.028	0.333333
10	100.2666	6.79E+08	1.24E+08	929.9192	0.190701	8605.374	0.450000
5	100.2623	6.46E+08	1.12E+08	927.8358	0.187453	8103.616	0.566667
2	100.2657	6.19E+08	96758184	925.0581	0.180394	7460.711	0.716667
1	100.2626	5.96E+08	86376621	924.3636	0.173893	7229.591	0.900000
0.5	100.259	5.71E+08	77085423	922.2803	0.166617	6797.596	1.116667
0.2	100.2617	5.27E+08	66700202	922.2803	0.157493	6608.468	1.533333
0.1	100.2556	5.01E+08	60072734	920.8914	0.150591	6240.991	2.283333
0.05	100.2629	4.82E+08	54335391	920.197	0.143965	5903.473	3.383333
0.02	100.4016	4.4E+08	47759850	919.5026	0.135437	5482.351	5.966667
0.01	100.5144	4.1E+08	42954798	918.8081	0.127277	5142.337	11.05000

ตารางที่ C.78 DMA data of sPS2 blended with PBMA for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	120.2208	5.77E+08	1.74E+08	575.0603	0.197712	5880.429	0.133333
50	120.1298	5.18E+08	1.59E+08	594.5046	0.200681	9806.65	0.233333
20	120.0385	4.74E+08	1.32E+08	584.7825	0.183313	6021.776	0.350000
10	119.9508	4.49E+08	1.13E+08	584.088	0.170045	6021.776	0.447713
5	119.869	4.35E+08	96598792	584.088	0.156984	6021.776	0.566667
2	119.7801	4.21E+08	78302764	584.088	0.138761	6021.776	0.716667
1	119.6678	4.03E+08	67490445	584.7825	0.126687	6021.776	0.900000
0.5	119.5632	3.85E+08	58607939	585.4769	0.115817	6021.776	1.116667
0.2	119.4231	3.73E+08	50098191	586.1714	0.105193	6021.776	1.533333
0.1	119.362	3.57E+08	44904621	587.5602	0.098426	6021.776	2.283333
0.05	119.5811	3.46E+08	40897052	589.6436	0.093437	6021.776	3.366667
0.02	120.6773	3.24E+08	37389468	591.7269	0.090193	6021.776	5.966667
0.01	121.5016	3.1E+08	34536911	596.588	0.086576	5851.247	11.05000

ตารางที่ C.79 DMA data of sPS2 blended with PBMA for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	140.8597	4.49E+08	52848275	626.4489	0.1143	7465.307	0.133333
50	140.8413	4.21E+08	45782569	628.5322	0.101723	6825.542	0.233333
20	140.8266	4.12E+08	36535941	628.5322	0.084441	6586.728	0.333333
10	140.8119	3.94E+08	31909426	628.5322	0.07574	6208.914	0.450000
5	140.7981	3.82E+08	28887903	627.8378	0.070246	5878.668	0.566667
2	140.765	3.78E+08	26167203	626.4489	0.065597	5527.138	0.716667
1	140.7435	3.66E+08	25023145	625.7545	0.064111	5310.419	0.900000
0.5	140.725	3.61E+08	24225781	625.06	0.063341	5125.988	1.116667
0.2	140.701	3.46E+08	23883655	624.3655	0.064143	4920.024	1.533333
0.1	140.7147	3.27E+08	24058466	624.3655	0.06596	4913.906	2.283333
0.05	140.8116	3.17E+08	24062261	624.3655	0.067303	4744.387	3.366667
0.02	141.1393	3.03E+08	24082127	624.3655	0.069152	4528.979	5.950000
0.01	141.5033	2.94E+08	23601749	625.06	0.068939	4393.244	11.03333

ตารางที่ C.80 DMA data of sPS2 blended with PBMA for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	160.5002	3.98E+08	26792133	244.5069	0.065098	6065.798	0.116667
50	160.4391	3.69E+08	24371648	236.868	0.059744	4292.32	0.233333
20	160.3686	3.61E+08	22042495	234.7847	0.054989	4015.556	0.333333
10	160.2965	3.5E+08	21008374	235.4792	0.053365	4299.357	0.450000
5	160.2193	3.39E+08	20217043	235.4792	0.052302	4227.502	0.566667
2	160.1288	3.35E+08	19849318	235.4792	0.05261	4130.894	0.700000
1	160.0393	3.31E+08	19791961	235.4792	0.053432	4056.834	0.883333
0.5	159.927	3.27E+08	22049118	243.8124	0.061707	6200	1.100000
0.2	159.7986	3.21E+08	23252248	245.8958	0.066984	6200	1.533333
0.1	159.7201	3.07E+08	23310850	246.5902	0.068638	5842.711	2.283333
0.05	159.9267	2.97E+08	23973785	248.6735	0.072207	5842.711	3.366667
0.02	161.0155	2.81E+08	24204982	250.0624	0.075486	5573.512	5.950000
0.01	161.5773	2.69E+08	24222927	254.229	0.077465	5573.512	11.03333

ตารางที่ C.81 DMA data of sPS2 blended with PBMA for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	180.3842	3.21E+08	19466337	268.8123	0.055278	4082.757	0.133333
50	180.373	3.17E+08	19222508	271.59	0.055587	4258.343	0.233333
20	180.3609	3.1E+08	18453924	272.9789	0.054436	4292.207	0.350000
10	180.3558	3.03E+08	18176556	272.9789	0.054621	4232.135	0.450000
5	180.346	3.01E+08	18175068	272.9789	0.055674	4199.316	0.566667
2	180.3266	2.9E+08	18261629	272.9789	0.057411	4110.425	0.700000
1	180.304	2.88E+08	18407822	272.9789	0.059052	4046.258	0.883333
0.5	180.2995	2.81E+08	18556454	272.9789	0.06072	3924.034	1.100000
0.2	180.3008	2.81E+08	18816519	272.9789	0.063327	3828.279	1.516667
0.1	180.3402	2.72E+08	18914651	272.9789	0.065015	3755.312	2.266667
0.05	180.4319	2.67E+08	18867701	272.9789	0.066333	3681.251	3.350000
0.02	180.6343	2.58E+08	18453125	272.2845	0.066744	3576.718	5.933333
0.01	180.7282	2.47E+08	18275192	272.2845	0.06733	3503.815	11.01667

ตารางที่ C.82 DMA data of sPS2 blended with PEMA for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.58118	2.18E+09	63178237	108.3966	0.054219	6200	0.183333
50	60.51792	2.16E+09	68247622	104.9244	0.056825	6200	0.300000
20	60.43922	2.15E+09	69506953	105.6189	0.058167	6200	0.400000
10	60.37904	2.13E+09	67393188	105.6189	0.057057	6200	0.516667
5	60.31207	2.09E+09	68599946	106.3133	0.059195	6200	0.633333
2	60.21702	2.05E+09	71085537	106.3133	0.062933	6200	0.766667
1	60.09388	2.02E+09	72756831	107.0078	0.065828	6200	0.950000
0.5	59.94729	1.98E+09	73002646	107.0078	0.067744	6200	1.166667
0.2	59.66398	1.94E+09	76084946	107.7022	0.072744	6200	1.583333
0.1	59.20507	1.84E+09	79522729	108.3966	0.077979	6200	2.350000
0.05	58.54155	1.75E+09	85824395	109.7855	0.085641	6200	3.433333
0.02	56.88089	1.60E+09	84955273	110.48	0.087004	6200	6.016667
0.01	55.96616	1.44E+09	80995044	111.8688	0.083253	6200	11.10000

ตารางที่ C.83 DMA data of sPS2 blended with PEMA for temperature 70 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	71.23044	2.08E+09	71852314	100.7578	0.066019	6200	0.183333
50	71.14113	2.05E+09	83039609	97.98004	0.075419	6200	0.300000
20	71.05397	1.96E+09	76954502	97.98004	0.070829	6200	0.400000
10	70.97234	1.91E+09	76658120	97.98004	0.07218	6200	0.516667
5	70.87965	1.87E+09	79142134	98.67448	0.076185	6200	0.633333
2	70.77193	1.81E+09	79466528	98.67448	0.079242	6200	0.766667
1	70.62155	1.75E+09	78408516	98.67448	0.080436	6200	0.950000
0.5	70.44785	1.71E+09	78346772	98.67448	0.082527	6200	1.166667
0.2	70.12718	1.65E+09	80267974	98.67448	0.087434	6200	1.583333
0.1	69.53476	1.57E+09	83048232	99.36892	0.093002	6200	2.333333
0.05	68.72329	1.46E+09	83250957	99.36892	0.09541	6200	3.416667
0.02	67.28871	1.24E+09	86897842	99.36892	0.101715	6200	6000000
0.01	67.17612	1.02E+09	85370186	99.36892	0.100418	6200	11.08333

ตารางที่ C.84 DMA data of sPS2 blended with PEMA for temperature 81.95 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	82.14622	1.65E+09	82130342	128.5354	0.089708	9806.65	0.183333
50	82.33426	1.56E+09	92793418	132.702	0.101903	9806.65	0.300000
20	82.50024	1.42E+09	91490459	133.3965	0.104731	9806.65	0.400000
10	82.67143	1.36E+09	91726875	134.7854	0.109606	9806.65	0.516667
5	82.83956	1.20E+09	92015508	136.1742	0.115296	9806.65	0.633333
2	83.01688	1.12E+09	92786348	136.8687	0.12432	9806.65	0.783333
1	83.23676	1.06E+09	93636299	137.5631	0.132798	9806.65	0.966667
0.5	83.4594	9.98E+08	93856963	139.6464	0.141134	9806.65	1.183333
0.2	83.77758	9.16E+08	94298330	140.3409	0.154358	9806.65	1.600000
0.1	84.06667	8.02E+08	93944561	143.1186	0.165447	9806.65	2.350000
0.05	83.93775	6.78E+08	94205488	147.2853	0.177531	9806.65	3.433333
0.02	82.29904	5.48E+08	94640146	150.063	0.190764	9806.65	6.016667
0.01	80.13872	4.15E+08	92556611	154.2297	0.183185	9806.65	11.10000

ตารางที่ C.85 DMA data of sPS2 blended with PEMA for temperature 90 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	90.86415	1.42E+09	1.01E+08	159.7852	0.127319	9806.65	0.133333
50	90.75282	1.25E+09	1.06E+08	163.2574	0.136564	9806.65	0.233333
20	90.64822	1.14E+09	1.05E+08	164.6463	0.145338	9806.65	0.350000
10	90.53689	1.08E+09	1.05E+08	166.0352	0.152699	9806.65	0.450000
5	90.4231	1.01E+09	1.04E+08	166.0352	0.160878	9477.769	0.566667
2	90.29152	9.27E+08	1.01E+08	166.0352	0.170657	8989.5	0.716667
1	90.12375	8.66E+08	97638145	166.0352	0.177434	8573.503	0.883333
0.5	89.92194	8.07E+08	94043721	165.3407	0.183349	8189.391	1.116667
0.2	89.56738	6.90E+08	89335166	163.9518	0.191059	7641.895	1.533333
0.1	89.04321	5.86E+08	85087617	163.9518	0.194211	7214.68	2.283333
0.05	88.55769	4.84E+08	81014863	163.9518	0.19751	6844.204	3.366667
0.02	88.45771	3.77E+08	74736401	163.9518	0.201349	6532.826	5.933333
0.01	89.75539	3.36E+08	64486411	167.424	0.194221	6594.297	11.03333

ตารางที่ C.86 DMA data of sPS2 blended with PEMA for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1482	9.31E+08	91379870	85.48012	0.047423	6200	0.133333
50	60.09882	7.98E+08	1.01E+08	89.64676	0.05037	5970.336	0.233333
20	60.0445	6.65E+08	96669544	90.3412	0.048249	5959.019	0.350000
10	59.98988	6.21E+08	94502676	90.3412	0.047895	5959.019	0.450000
5	59.93649	5.33E+08	93664408	90.3412	0.04824	5959.019	0.566667
2	59.86643	4.70E+08	95869668	90.3412	0.05059	5959.019	0.716667
1	59.76953	4.44E+08	1.01E+08	91.03564	0.054323	5959.019	0.900000
0.5	59.64732	4.03E+08	1.03E+08	91.03564	0.056467	5959.019	1.116667
0.2	59.39888	3.56E+08	1.1E+08	91.03564	0.061852	5959.019	1.533333
0.1	58.91682	3.20E+08	1.14E+08	91.03564	0.065862	5959.019	2.283333
0.05	58.16072	2.99E+08	1.22E+08	91.73008	0.071811	5959.019	3.366667
0.02	56.54018	2.67E+08	1.31E+08	92.42452	0.079305	5959.019	5.950000
0.01	56.29823	2.52E+08	1.21E+08	92.42452	0.07415	5959.019	11.03333

ตารางที่ C.87 DMA data of sPS2 blended with PEMA for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	119.437	4.61E+08	95422090	262.5623	0.231445	2611.057	0.133333
50	119.5944	3.73E+08	80095928	259.7845	0.21486	2883.29	0.233333
20	119.7437	3.39E+08	64362603	259.7845	0.187318	2794.203	0.350000
10	119.9017	3.24E+08	55011597	259.7845	0.169859	2744.279	0.450000
5	120.061	3.07E+08	47298105	259.7845	0.153943	2683.942	0.566667
2	120.2511	2.90E+08	39906680	259.0901	0.137762	2603.261	0.716667
1	120.4884	2.79E+08	35772502	259.0901	0.128331	2545.201	0.900000
0.5	120.7446	2.69E+08	32787161	259.0901	0.121699	2492.45	1.116667
0.2	121.1501	2.59E+08	30300334	258.3957	0.117127	2428.971	1.533333
0.1	121.6913	2.52E+08	29206758	257.7012	0.1158	2384.94	2.283333
0.05	122.1266	2.39E+08	28573992	257.0068	0.115727	2342.659	3.366667
0.02	121.7584	2.27E+08	28496260	255.6179	0.118223	2291.916	5.950000
0.01	120.6011	2.20E+08	30428003	253.5346	0.126236	2262.331	11.03333

ตารางที่ C.88 DMA data of sPS2 blended with PEMA for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	139.9812	2.81E+08	48187144	279.9233	0.171312	5187.111	0.133333
50	139.9762	2.68E+08	40579446	286.1733	0.15148	4973.236	0.233333
20	139.9674	2.63E+08	33980542	281.3122	0.128972	3522.934	0.350000
10	139.9577	2.56E+08	30043560	279.9233	0.117224	3302.923	0.450000
5	139.9621	2.5E+08	27032454	278.5345	0.108134	3115.761	0.566667
2	139.9677	2.42E+08	24885557	277.84	0.102784	2916.276	0.716667
1	139.978	2.37E+08	23687195	277.1456	0.100081	2794.215	0.900000
0.5	140.0065	2.32E+08	22720464	276.4511	0.098129	2696.844	1.116667
0.2	140.0568	2.25E+08	22088113	276.4511	0.098204	2587.095	1.533333
0.1	140.2589	2.2E+08	21482258	276.4511	0.097527	2518.904	2.283333
0.05	140.5763	2.16E+08	21174260	276.4511	0.098126	2458.52	3.366667
0.02	141.2243	2.1E+08	20732668	276.4511	0.098677	2386.425	5.950000
0.01	141.3196	1.99E+08	22973018	282.0067	0.115246	3172.17	11.03333

ตารางที่ C.89 DMA data of sPS2 blended with PEMA for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.5439	2.45E+08	27771624	314.6453	0.113568	3609.372	0.133333
50	159.5993	2.36E+08	25231743	319.5064	0.106748	3636.603	0.233333
20	159.6455	2.3E+08	23413340	321.5897	0.101695	3537.484	0.350000
10	159.6869	2.24E+08	22519863	322.9786	0.100336	3492.043	0.450000
5	159.7372	2.19E+08	21928389	323.673	0.100317	3422.531	0.583333
2	159.802	2.11E+08	21406350	323.673	0.101376	3320.296	0.716667
1	159.8951	2.06E+08	21075071	324.3675	0.102536	3256.383	0.900000
0.5	160.0175	2E+08	20717451	325.0619	0.103404	3195.049	1.116667
0.2	160.2168	1.94E+08	20480042	325.7563	0.105649	3111.953	1.533333
0.1	160.609	1.89E+08	20310304	326.4508	0.107371	3055.382	2.283333
0.05	161.0111	1.85E+08	20234318	328.5341	0.109573	3006.606	3.366667
0.02	161.3464	1.79E+08	19952756	329.2285	0.111292	2809.508	5.966667
0.01	161.0114	1.77E+08	19089213	330.6174	0.10784	2704.578	11.05000

ตารางที่ C.90 DMA data of sPS2 blended with PEMA for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	180.7346	2.14E+08	22273960	358.3951	0.103967	2956.284	0.133333
50	180.7648	2.07E+08	20964438	361.8672	0.101164	3194.609	0.233333
20	180.7887	2.01E+08	20483145	365.3394	0.101768	3316.15	0.350000
10	180.8126	1.96E+08	19964868	365.3394	0.101719	2976.084	0.450000
5	180.8406	1.91E+08	19596259	365.3394	0.102517	2910.515	0.566667
2	180.8702	1.84E+08	19089291	365.3394	0.103471	2824.582	0.700000
1	180.9087	1.8E+08	18641866	365.3394	0.103706	2759.036	0.883333
0.5	180.9415	1.75E+08	18148491	365.3394	0.103441	2699.071	1.100000
0.2	180.9937	1.7E+08	17677997	365.3394	0.103892	2625.069	1.516667
0.1	181.0322	1.66E+08	17337361	365.3394	0.104129	2570.67	2.266667
0.05	181.0023	1.63E+08	17045284	365.3394	0.104556	2519.626	3.350000
0.02	180.803	1.59E+08	16723840	365.3394	0.105144	2462.882	5.933333
0.01	180.5283	1.56E+08	16830630	365.3394	0.107605	2431.301	11.01667

ตารางที่ C.91 DMA data of sPS2 blended with PHMA for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	62.10234	2.53E+09	2.12E+08	1122.974	0.148109	6200	0.133333
50	62.06253	2.50E+09	2E+08	1133.39	0.12776	6016.666	0.233333
20	62.00204	2.5E+09	2.01E+08	1134.779	0.128262	6061.75	0.350000
10	61.9465	2.47E+09	2.03E+08	1135.473	0.130202	6061.75	0.466667
5	61.89465	2.44E+09	2.06E+08	1136.168	0.134029	6061.75	0.583333
2	61.83786	2.41E+09	2.12E+08	1136.168	0.141704	6061.75	0.716667
1	61.74528	2.38E+09	2.18E+08	1136.862	0.14829	6061.75	0.900000
0.5	61.63942	2.29E+09	2.25E+08	1137.557	0.155958	6061.75	1.116667
0.2	61.44191	2.29E+09	2.42E+08	1138.251	0.173123	6061.75	1.533333
0.1	61.05707	2.23E+09	2.56E+08	1139.64	0.188882	6061.75	2.300000
0.05	60.50403	2.18E+09	2.9E+08	1141.723	0.220179	6061.75	3.383333
0.02	59.11773	2.15E+09	2.61E+08	1144.501	0.201326	5698.545	5.966667
0.01	56.65036	2.07E+09	3.44E+08	1145.196	0.272509	5958.031	11.05000

ตารางที่ C.92 DMA data of sPS2 blended with PHMA for temperature 70 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	72.60872	2.18E+09	98702261	93.8134	0.049328	6200	0.183333
50	72.49578	2.13E+09	1.18E+08	94.50784	0.055835	5927.74	0.300000
20	72.38284	2.11E+09	1.18E+08	94.50784	0.05595	5927.74	0.400000
10	72.27758	2.08E+09	1.23E+08	95.20228	0.059066	5927.74	0.516667
5	72.1585	2.03E+09	1.29E+08	95.20228	0.063552	5927.74	0.633333
2	72.00444	1.97E+09	1.38E+08	95.20228	0.070326	5927.74	0.766667
1	71.81447	1.95E+09	1.43E+08	95.20228	0.074376	5927.74	0.950000
0.5	71.58092	1.93E+09	1.53E+08	95.89672	0.082114	5927.74	1.166667
0.2	71.15064	1.88E+09	1.66E+08	95.89672	0.092884	5927.74	1.583333
0.1	70.39413	1.83E+09	1.77E+08	95.89672	0.10163	5927.74	2.333333
0.05	69.34025	1.77E+09	1.86E+08	95.89672	0.110173	5927.74	3.416667
0.02	67.33719	1.7E+09	2.04E+08	95.89672	0.124222	5927.74	6.000000
0.01	67.03193	1.62E+09	1.93E+08	95.89672	0.118713	5927.74	11.08333

ตารางที่ C.93 DMA data of sPS2 blended with PHMA for temperature 79.22 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	79.1608	1.83E+09	1.53E+08	111.8688	0.091535	9806.65	0.133333
50	79.24088	1.77E+09	1.81E+08	117.4244	0.104314	9806.65	0.233333
20	79.32987	1.7E+09	1.87E+08	119.5077	0.109733	9806.65	0.333333
10	79.40382	1.65E+09	1.92E+08	121.591	0.11642	9806.65	0.450000
5	79.48207	1.59E+09	2E+08	122.9799	0.125777	9806.65	0.566667
2	79.58118	1.52E+09	2.1E+08	124.3688	0.140527	9806.65	0.716667
1	79.68919	1.42E+09	2.19E+08	126.4521	0.154251	9806.65	0.900000
0.5	79.79475	1.34E+09	2.28E+08	128.5354	0.170254	9806.65	1.116667
0.2	79.9853	1.22E+09	2.42E+08	131.3132	0.197374	9806.65	1.533333
0.1	80.18229	1.13E+09	2.51E+08	134.7854	0.222913	9806.65	2.283333
0.05	80.25962	1.02E+09	2.61E+08	140.3409	0.255481	9806.65	3.366667
0.02	79.63181	8.87E+08	2.74E+08	147.9797	0.308556	9806.65	5.966667
0.01	78.6591	7.93E+08	2.93E+08	161.1741	0.369002	9806.65	11.05000

ตารางที่ C.94 DMA data of sPS2 blended with PHMA for temperature 90 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	92.00572	1.57E+09	1.54E+08	108.3966	0.098334	6200	0.133333
50	91.96217	1.57E+09	1.82E+08	110.48	0.115733	6200	0.233333
20	91.90604	1.5E+09	1.88E+08	111.1744	0.12579	5662.32	0.333333
10	91.85083	1.41E+09	1.91E+08	111.8688	0.135065	5662.32	0.450000
5	91.79562	1.32E+09	1.95E+08	112.5633	0.147356	5662.32	0.566667
2	91.72232	1.2E+09	1.97E+08	113.2577	0.164491	5662.32	0.716667
1	91.62325	1.1E+09	1.97E+08	114.6466	0.178499	5662.32	0.900000
0.5	91.50548	1.01E+09	1.96E+08	115.341	0.193678	5662.32	1.116667
0.2	91.2598	8.94E+08	1.94E+08	116.7299	0.216542	5662.32	1.533333
0.1	90.80312	8.09E+08	1.91E+08	118.8132	0.235932	5662.32	2.283333
0.05	90.2449	7.23E+08	1.93E+08	122.2854	0.267122	6063.884	3.366667
0.02	89.38795	6.23E+08	1.84E+08	126.4521	0.295246	5957.757	5.966667
0.01	89.7146	5.38E+08	1.71E+08	133.3965	0.318081	5904.978	11.05000

ตารางที่ C.95 DMA data of sPS2 blended with PHMA for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	100.2721	1.38E+09	1.77E+08	125.0632	0.128886	9806.65	0.133333
50	100.2062	1.22E+09	2.03E+08	134.7854	0.15252	9806.65	0.250000
20	100.14	1.06E+09	2E+08	137.5631	0.165103	9806.65	0.350000
10	100.0697	9.75E+08	1.95E+08	140.3409	0.175396	9806.65	0.466667
5	99.99734	8.83E+08	1.88E+08	142.4242	0.186171	9806.65	0.583333
2	99.91145	8.11E+08	1.78E+08	143.8131	0.200869	9806.65	0.733333
1	99.81515	7.43E+08	1.7E+08	146.5908	0.21303	9806.65	0.916667
0.5	99.7029	6.81E+08	1.63E+08	150.063	0.226948	9806.65	1.133333
0.2	99.54003	6.21E+08	1.53E+08	152.8408	0.246301	9806.65	1.550000
0.1	99.34404	5.54E+08	1.4E+08	157.7019	0.252916	9063.123	2.300000
0.05	99.34097	4.86E+08	1.28E+08	162.563	0.264194	9097.972	3.383333
0.02	99.96881	4.05E+08	1.03E+08	166.7296	0.254615	7892.332	5.966667
0.01	100.808	3.5E+08	80793575	170.2018	0.230594	7230.393	11.05000

ตารางที่ C.96 DMA data of sPS2 blended with PHMA for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	120.7041	6.88E+08	1.53E+08	147.2853	0.223003	6200	0.133333
50	120.6393	6.27E+08	1.45E+08	148.6742	0.231585	6200	0.233333
20	120.5733	5.44E+08	1.28E+08	149.3686	0.23508	6200	0.333333
10	120.5125	4.86E+08	1.14E+08	150.063	0.235425	6200	0.450000
5	120.443	4.34E+08	1E+08	150.7575	0.230505	6200	0.566667
2	120.3718	3.78E+08	80181388	151.4519	0.212288	6200	0.716667
1	120.2829	3.45E+08	65864283	152.1464	0.19093	6200	0.900000
0.5	120.1955	3.2E+08	53335823	152.8408	0.16671	6200	1.116667
0.2	120.0638	2.96E+08	41080400	153.5352	0.138935	6200	1.533333
0.1	119.9687	2.81E+08	34564113	154.9241	0.122788	6200	2.283333
0.05	120.0752	2.7E+08	30147539	157.7019	0.111838	6200	3.383333
0.02	120.8865	2.56E+08	26080885	157.7019	0.101745	5639.326	5.950000
0.01	121.5202	2.48E+08	24065094	161.8685	0.097029	5639.326	11.05000

ตารางที่ C.97 DMA data of sPS2 blended with PHMA for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	139.894	3.32E+08	84117279	193.8128	0.227701	7700.617	0.133333
50	139.8456	3.05E+08	70178768	197.285	0.207062	7357.109	0.233333
20	139.8003	2.76E+08	52181668	200.0627	0.170046	7245.553	0.333333
10	139.7556	2.62E+08	41126213	196.5905	0.141317	6009.39	0.450000
5	139.7143	2.51E+08	33004809	194.5072	0.118195	5459.642	0.566667
2	139.6678	2.41E+08	25991521	191.7294	0.097133	4835.697	0.716667
1	139.6134	2.35E+08	22713401	189.6461	0.08717	4428.775	0.900000
0.5	139.5834	2.28E+08	20559276	189.6461	0.080994	4494.793	1.116667
0.2	139.5566	2.21E+08	18952036	189.6461	0.077077	4182.947	1.533333
0.1	139.6893	2.16E+08	18081859	189.6461	0.075373	4000.483	2.283333
0.05	140.0833	2.1E+08	17730964	189.6461	0.075814	3848.507	3.366667
0.02	141.3005	2.03E+08	17729421	190.3406	0.078691	3686.71	5.950000
0.01	141.7525	1.98E+08	18428493	193.1183	0.083607	3591.175	11.03333

ตารางที่ C.98 DMA data of sPS2 blended with PHMA for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	159.0928	2.4E+08	31347996	218.1182	0.117329	4410.545	0.133333
50	158.9688	2.35E+08	25745903	222.2848	0.098769	4347.788	0.233333
20	158.8641	2.27E+08	20765188	223.6737	0.082399	4171.517	0.350000
10	158.7569	2.21E+08	18510948	224.3681	0.075325	4113.748	0.450000
5	158.6474	2.16E+08	17250422	225.0626	0.071792	3961.088	0.566667
2	158.5396	2.1E+08	16252032	225.0626	0.069689	3810.598	0.716667
1	158.4425	2.05E+08	15929404	225.0626	0.069861	3720.728	0.900000
0.5	158.3349	2.01E+08	15804522	225.757	0.070882	3635.505	1.116667
0.2	158.2517	1.95E+08	15890485	226.4514	0.073465	3535.17	1.533333
0.1	158.4089	1.9E+08	16024083	227.1459	0.07595	3459.117	2.283333
0.05	159.1453	1.85E+08	16281500	229.9236	0.079322	3384.684	3.366667
0.02	161.3834	1.77E+08	18023514	232.7014	0.091689	3282.693	5.950000
0.01	162.0486	1.73E+08	17798002	237.5625	0.092643	3036.048	11.05000

ตารางที่ C.99 DMA data of sPS2 blended with PHMA for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	178.1062	1.92E+08	17563799	261.8679	0.077756	3407.474	0.133333
50	178.1559	1.89E+08	16089206	266.0345	0.072466	3491.729	0.233333
20	178.2093	1.83E+08	14897840	269.5067	0.069177	3611.269	0.333333
10	178.2673	1.79E+08	14335603	270.2012	0.068026	3328.984	0.450000
5	178.337	1.75E+08	14057241	270.8956	0.068242	3267.157	0.566667
2	178.4172	1.7E+08	13972669	271.5900	0.069901	3182.945	0.716667
1	178.534	1.66E+08	13982625	272.2845	0.071618	3122.037	0.900000
0.5	178.6941	1.62E+08	14042753	273.6734	0.073645	3061.696	1.116667
0.2	179.0175	1.57E+08	14391761	274.3678	0.077882	2983.134	1.533333
0.1	179.5904	1.53E+08	14559750	276.4511	0.080909	2918.564	2.283333
0.05	180.4061	1.49E+08	14844205	279.2289	0.084825	2848.663	3.366667
0.02	181.5223	1.43E+08	16644516	282.0067	0.098639	2842.644	5.966667
0.01	181.2884	1.41E+08	15386760	286.8677	0.092727	2890.381	11.05000

ตารางที่ C.100 DMA data of sPS2 blended with PaMS for temperature 60 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1482	2E+09	91379870	85.48012	0.047423	6200	0.133333
50	60.09882	2.02E+09	1.01E+08	89.64676	0.05037	5970.336	0.233333
20	60.0445	2E+09	96669544	90.3412	0.048249	5959.019	0.350000
10	59.98988	2.02E+09	94502676	90.3412	0.047895	5959.019	0.450000
5	59.93649	2.02E+09	93664408	90.3412	0.04824	5959.019	0.566667
2	59.86643	2.06E+09	95869668	90.3412	0.05059	5959.019	0.716667
1	59.76953	2.04E+09	1.01E+08	91.03564	0.054323	5959.019	0.900000
0.5	59.64732	2E+09	1.03E+08	91.03564	0.056467	5959.019	1.116667
0.2	59.39888	1.95E+09	1.1E+08	91.03564	0.061852	5959.019	1.533333
0.1	58.91682	1.87E+09	1.14E+08	91.03564	0.065862	5959.019	2.283333
0.05	58.16072	1.81E+09	1.22E+08	91.73008	0.071811	5959.019	3.366667
0.02	56.54018	1.73E+09	1.31E+08	92.42452	0.079305	5959.019	5.950000
0.01	56.29823	1.59E+09	1.21E+08	92.42452	0.07415	5959.019	11.03333

ตารางที่ C.101 DMA data of sPS2 blended with PaMS for temperature 70 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1482	2E+09	91379870	85.48012	0.047423	6200	0.133333
50	60.09882	2.02E+09	1.01E+08	89.64676	0.05037	5970.336	0.233333
20	60.0445	2E+09	96669544	90.3412	0.048249	5959.019	0.350000
10	59.98988	2.02E+09	94502676	90.3412	0.047895	5959.019	0.450000
5	59.93649	2.02E+09	93664408	90.3412	0.04824	5959.019	0.566667
2	59.86643	2.06E+09	95869668	90.3412	0.05059	5959.019	0.716667
1	59.76953	2.04E+09	1.01E+08	91.03564	0.054323	5959.019	0.900000
0.5	59.64732	2E+09	1.03E+08	91.03564	0.056467	5959.019	1.116667
0.2	59.39888	1.95E+09	1.1E+08	91.03564	0.061852	5959.019	1.533333
0.1	58.91682	1.87E+09	1.14E+08	91.03564	0.065862	5959.019	2.283333
0.05	58.16072	1.81E+09	1.22E+08	91.73008	0.071811	5959.019	3.366667
0.02	56.54018	1.73E+09	1.31E+08	92.42452	0.079305	5959.019	5.950000
0.01	56.29823	1.59E+09	1.21E+08	92.42452	0.07415	5959.019	11.03333

ตารางที่ C.102 DMA data of sPS2 blended with PaMS for temperature 80 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1482	2.00E+09	91379870	85.48012	0.047423	6200.000	0.133333
50	60.09882	2.02E+09	1.01E+08	89.64676	0.05037	5970.336	0.233333
20	60.0445	2.00E+09	96669544	90.3412	0.048249	5959.019	0.350000
10	59.98988	2.02E+09	94502676	90.3412	0.047895	5959.019	0.450000
5	59.93649	2.02E+09	93664408	90.3412	0.04824	5959.019	0.566667
2	59.86643	2.06E+09	95869668	90.3412	0.05059	5959.019	0.716667
1	59.76953	2.04E+09	1.01E+08	91.03564	0.054323	5959.019	0.900000
0.5	59.64732	2.00E+09	1.03E+08	91.03564	0.056467	5959.019	1.116667
0.2	59.39888	1.95E+09	1.1E+08	91.03564	0.061852	5959.019	1.533333
0.1	58.91682	1.87E+09	1.14E+08	91.03564	0.065862	5959.019	2.283333
0.05	58.16072	1.81E+09	1.22E+08	91.73008	0.071811	5959.019	3.366667
0.02	56.54018	1.73E+09	1.31E+08	92.42452	0.079305	5959.019	5.950000
0.01	56.29823	1.59E+09	1.21E+08	92.42452	0.07415	5959.019	11.03333

ตารางที่ C.103 DMA data of sPS2 blended with PaMS for temperature 90.24 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	60.1482	2.00E+09	91379870	85.48012	0.047423	6200.000	0.133333
50	60.09882	2.02E+09	1.01E+08	89.64676	0.05037	5970.336	0.233333
20	60.0445	2.00E+09	96669544	90.3412	0.048249	5959.019	0.350000
10	59.98988	2.02E+09	94502676	90.3412	0.047895	5959.019	0.45000
5	59.93649	2.02E+09	93664408	90.3412	0.04824	5959.019	0.566667
2	59.86643	2.06E+09	95869668	90.3412	0.05059	5959.019	0.716667
1	59.76953	2.04E+09	1.01E+08	91.03564	0.054323	5959.019	0.900000
0.5	59.64732	2.00E+09	1.03E+08	91.03564	0.056467	5959.019	1.116667
0.2	59.39888	1.95E+09	1.1E+08	91.03564	0.061852	5959.019	1.533333
0.1	58.91682	1.87E+09	1.14E+08	91.03564	0.065862	5959.019	2.283333
0.05	58.16072	1.81E+09	1.22E+08	91.73008	0.071811	5959.019	3.366667
0.02	56.54018	1.73E+09	1.31E+08	92.42452	0.079305	5959.019	5.950000
0.01	56.29823	1.59E+09	1.21E+08	92.42452	0.07415	5959.019	11.03333

ตารางที่ C.104 DMA data of sPS2 blended with PaMS for temperature 100 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	99.63081	8.57E+08	1.53E+08	1780.046	0.08545	8825.985	0.133333
50	99.76914	8.3E+08	1.76E+08	1783.796	0.097878	8825.985	0.233333
20	99.91391	7.96E+08	1.96E+08	1787.546	0.115639	8825.985	0.333333
10	100.063	7.62E+08	2.11E+08	1790.671	0.133749	8825.985	0.450000
5	100.2209	7.16E+08	2.27E+08	1792.546	0.156274	8825.985	0.566667
2	100.3755	6.65E+08	2.42E+08	1795.046	0.190543	8825.985	0.716667
1	100.5733	5.82E+08	2.45E+08	1797.546	0.219319	8825.985	0.900000
0.5	100.777	4.82E+08	2.39E+08	1800.046	0.247387	8825.985	1.116667
0.2	101.1184	3.82E+08	2.19E+08	1803.171	0.280715	8825.985	1.533333
0.1	101.4784	3.16E+08	1.96E+08	1807.546	0.30183	8825.985	2.283333
0.05	100.9469	2.51E+08	1.87E+08	1816.296	0.306698	8825.985	3.383333
0.02	99.06187	2.11E+08	1.59E+08	1823.171	0.306797	8825.985	5.966667
0.01	99.45415	1.82E+08	1.23E+08	1829.421	0.300066	7545.71	11.05

ตารางที่ C.105 DMA data of sPS2 blended with PaMS for temperature 120 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	119.6129	3.39E+08	2.07E+08	1868.796	0.321775	8825.985	0.133333
50	119.666	2.82E+08	1.9E+08	1888.171	0.331197	8825.985	0.233333
20	119.7089	2.42E+08	1.54E+08	1899.42	0.336753	8825.985	0.333333
10	119.7589	2.03E+08	1.26E+08	1906.92	0.328278	8825.985	0.450000
5	119.8079	1.74E+08	1.02E+08	1913.795	0.309228	8825.985	0.566667
2	119.8804	1.58E+08	75232739	1918.795	0.274083	8743.16	0.716667
1	119.9786	1.44E+08	59080673	1918.17	0.242845	8023.981	0.900000
0.5	120.1082	1.36E+08	46322955	1912.545	0.211387	7186.646	1.116667
0.2	120.3792	1.31E+08	33090788	1901.92	0.16918	6108.433	1.533333
0.1	120.7686	1.24E+08	25037811	1893.17	0.138234	5270.957	2.283333
0.05	121.1075	1.19E+08	19699327	1891.92	0.115562	5070.438	3.383333
0.02	119.9332	1.13E+08	15587166	1886.296	0.096915	4366.645	5.966667
0.01	120.7081	1.13E+08	12852528	1875.046	0.079829	3539.953	11.05000

ตารางที่ C.106 DMA data of sPS2 blended with PaMS for temperature 140 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	138.6777	1.5E+08	50933797	1888.795	0.230044	3786.532	0.133968
50	138.7024	1.38E+08	38857602	1903.17	0.191878	4692.132	0.283333
20	138.7421	1.31E+08	28005788	1897.545	0.149546	3858.571	0.416667
10	138.7896	1.27E+08	22261174	1891.296	0.12471	3321.762	0.566667
5	138.833	1.21E+08	18536746	1885.046	0.109444	2853.15	0.683333
2	138.8908	1.19E+08	15205029	1880.046	0.092301	2448.972	0.816667
1	138.9836	1.14E+08	13633431	1876.921	0.084018	2200.227	1.000000
0.5	139.0845	1.12E+08	12667458	1875.046	0.079152	2012.466	1.216667
0.2	139.3347	1.1E+08	12098386	1872.546	0.077035	1821.097	1.650000
0.1	139.8177	1.08E+08	11916873	1870.671	0.076893	1664.71	2.40000
0.05	140.5157	1.06E+08	11768639	1871.296	0.077791	1655.237	3.483333
0.02	140.8297	1.02E+08	11183488	1871.296	0.076388	1581.107	6.066667
0.01	138.0791	99984232	11946669	1870.671	0.08364	1630.388	11.15000

ตารางที่ C.107 DMA data of sPS2 blended with PaMS for temperature 160 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	°C	Pa	Pa	μm		mN	min
100	158.2346	1.2E+08	17728442	1890.045	0.102513	1813.571	0.133333
50	158.2767	1.14E+08	14602626	1894.42	0.08753	1913.867	0.233333
20	158.3162	1.11E+08	12096519	1894.42	0.07333	1783.622	0.333333
10	158.3618	1.09E+08	11019023	1893.796	0.068018	1730.972	0.450000
5	158.4035	1.08E+08	10467467	1891.92	0.065137	1570.651	0.566667
2	158.4599	1.06E+08	10210939	1891.92	0.0652	1532.487	0.716667
1	158.5475	1.03E+08	10172602	1891.92	0.066373	1512.512	0.883333
0.5	158.6664	1.01E+08	10264792	1891.92	0.068527	1494.605	1.100000
0.2	158.9087	98196959	10498425	1891.92	0.072439	1471.082	1.516667
0.1	159.4032	96182938	10654747	1892.546	0.075639	1455.422	2.283333
0.05	160.1298	94210225	10897182	1893.796	0.079752	1427.361	3.366667
0.02	161.1477	90177469	11153133	1895.67	0.085156	1420.023	5.950000
0.01	160.9402	88327927	11299780	1896.295	0.088508	1337.828	11.03333

ตารางที่ C.108 DMA data of sPS2 blended with PaMS for temperature 180 °C

Freq.	Temp.	E'(G')	E"(G")	dL	tanD	Ft	Time
Hz	Cel	Pa	Pa	um		mN	min
100	179.4153	97296684	9999484	1915.67	0.065533	1312.301	0.133333
50	179.5127	94210225	11034563	1920.67	0.076015	1485.201	0.233333
20	179.6111	93131809	9122418	1922.545	0.063437	1534.425	0.350000
10	179.7104	92277972	8992396	1923.795	0.06397	1542.067	0.450000
5	179.7998	90177469	8985957	1923.795	0.065292	1517.74	0.566667
2	179.9153	88327927	9021115	1923.795	0.067569	1498.34	0.716667
1	180.0465	88327927	9118717	1923.795	0.069929	1471.578	0.900000
0.5	180.2148	87518132	9250658	1923.795	0.072658	1444.333	1.116667
0.2	180.4886	86179327	9479744	1923.795	0.077	1405.834	1.533333
0.1	180.832	83898888	9655516	1923.795	0.08056	1372.973	2.283333
0.05	181.0491	81728460	9776749	1923.795	0.083737	1340.573	3.350000
0.02	180.7079	79164864	9810342	1923.795	0.086746	1298.712	5.933333
0.01	180.2037	77188682	9721326	1923.17	0.08816	1269.769	11.03333