Thesis Title Study of Dielectric Properties of Mixtures of Nitrile Rubber and Liquid Crystals

Name Pairote Jittham

Degree Master of Science (Physical Chemistry)

Thesis Supervisory Committee

Sauvarop Bualek	Dr.rer.nat.
Orapin Phaovibul	Dr.rer.nat.
I Ming Tang	Ph.D.
Pongtip Winothai	Ph.D.

Date of Graduation 27 December B.E. 2538 (1995)

ABSTRACT

Dielectric properties of the mixtures of nitrile rubber (NBR) and liquid crystals i.e. cholesteryl dodecyl carbonate (CDC), which is cholesteric liquid crystal, and SCE13,which exhibits smectic C* phase and therefore ferroelectric were studied.

The first part of this thesis was to determine the appropriate vulcanization condition of polymer dispersed liquid crystal (PDLC) using dicumyl peroxide (DCP) as a curing agent. From the measurement of tensile properties of the vulcanized films, 1 phr of DCP was found to give the most suitable result. In order to find appropriate temperature and cure time for PDLC film, isothermal differential scanning colorimetric measurement (DSC) was carried out. The results indicated that the suitable vulcanization time of PDLC films using 1 phr of DCP was 20 min at 175°C for thick films and 20 min at 165°C for thin films.

In the second part, maximum amount of CDC and SCE13 which were able to disperse homogeneously (as seen by naked eyes) in the vulcanized NBR film was investigated. It was found that the maximum quantity was 15% w/w for both CDC and SCE13 in nitrile rubber.

In the third part, dispersion of CDC and SCE13 in vulcanized PDLC films and phase transition temperatures of the films were investigated under optical microscope and recorded DSC diagrams. The results indicated that both CDC and SCE13 dispersed in PDLC films are spherical droplets of about 10-150 μm in diameters. The glass transition temperature (T_g) of vulcanized PDLC films were higher than that of pure NBR film. The melting point (T_m), smectic-cholesteric transition (T_{Sm-Ch}) and cholesteric-isotropic transition or clearing point (T_c) of CDC dispersed in vulcanized NBR films were lower than that of

pure CDC. This is similar to the melting point depression of any compound by contamination. On the other hand, only smectric C*-smectricA transition temperature (T_{SmC^*-SmA}) of SCE13 dispersed on vulcanized NBR films could be observed and it is not shifted.

In the last part, dielectric property of the PDLC films were measured at varying frequency and temperature. The results revealed that, at low frequency regions (100-2000 kHz) dielectric constants of the PDLC films decreased with increasing of frequency but at higher frequency region (2000-5000 kHz) no remarkable change of dielectric constants of the films could be observed. Dielectric constant of PDLC films containing SCE13 was higher than that of CDC because of the ferroelectric property of SCE13. The results obtained also showed that dielectric constant of the PDLC films slightly decreased with increasing temperature because of the higher degree of random motion. The rate of decreasing of dielectric constant with increasing temperature was increased as the concentration of liquid crystal increased. Dielectric constant was elevated when the vulcanized PDLC films were extended because the directional mechanical force enhanced the degree of order of the molecular alignment of liquid crystals which are dispersed in PDLC films.