

REFERENCES

- [1] Milgrom, L. R. *The Colours of Life: An Introduction to the Chemistry of Porphyrins and Related Compounds*. Oxford: OUP, 1975.
- [2] Thunell, S. "Porphyrins, Porphyrin Metabolism and Porphyrias. I. Update" *Scand. J. Clin. Lab. Invest.* 60 (2000): 509-540.
- [3] Kadish, K. M.; Smith, K. M.; Guilard, R. *The Porphyrin Handbook*. San Diego: Academic Press, 2000.
- [4] Graca, M.; Vicente, H.; Jaquinod, L.; Smith, K. M. "Oligomeric Porphyrin Arrays" *Chem. Commun.* 18 (1999): 1771-1782.
- [5] Rahiman, A. K.; Rajesh, K.; Bharathi, K. S.; Sreedaran, S.; Narayanan, V. "Catalytic Oxidation of Alkenes by Manganese(III) Porphyrin-Encapsulated Al, V, Si-Mesoporous Molecular Sieves" *Inorg. Chim. Acta* 362 (2009): 1491-1500.
- [6] Fukushima, K.; Tabata, K.; Okura, I. "Photochemical Properties of Water-Soluble Fluorinated Zinc Phthalocyanines and Their Photocytotoxicity Against HeLa cells" *J. Porphyrins Phthalocyanines* 2 (1998): 219-222.
- [7] Fang, Z.; Liu, B. "A Cationic Porphyrin-Based Self-Assembled Film for Mercury Ion Detection" *Tetrahedron Lett.* 49 (2008): 2311-2315.
- [8] Mizutani, T.; Wada, K.; Kitagawa, S. "Porphyrin Receptors for Amines, Amino Acids, and Oligopeptides in Water" *J. Am. Chem. Soc.* 121 (1999): 11425-11431.
- [9] Kathiravan, A.; Kumar, P. S.; Renganathan, R.; Anandan, S. "Photoinduced Electron Transfer Reactions Between *meso*-Tetrakis(4-sulfonatophenyl) porphyrin and Colloidal Metal-Semiconductor Nanoparticles" *Colloids and Surfaces A: Physicochem. Eng. Aspects* 333 (2002): 175-181.
- [10] Granstrom, M.; Petritsch, K.; Arias, A. C.; Lux, A.; Anderson, M. R.; Friend, R. H. "Laminated Fabrication of Polymeric Photovoltaic Diodes" *Nature* 395 (1998): 257-260.
- [11] Friend, R. H.; Gymer, R. W.; Holmes, A. B.; Burroughes, J. H.; Marks, R. N.; Taliani, C.; Bradley, D. D. C.; Dos Santos, D. A.; Bredas, J. L.; Logdlund, M.; Salaneck, W. R. "Electroluminescence in Conjugated Polymers" *Nature* 397 (1999): 121-128.

- [12] Gosztola, D.; Niemczyk, M. P.; Wasielewski, M. R. "Picosecond Molecular Switch Based on Bidirectional Inhibition of Photoinduced Electron Transfer Using Photogenerated Electric Fields" *J. Am. Chem. Soc.* 120 (1998): 5118-5119.
- [13] Senge, M. O.; Fazekas, M.; Notaras, E. G. A.; Blau, W. J.; Zawadzka, M.; Locos, O. B.; Mhuircheartaigh, E. M. N. "Nonlinear Optical Properties of Porphyrins" *Adv. Mater.* 19 (2007): 2737-2774.
- [14] de la Torre, G.; Vaquez, P.; Agullo-Lopez, F.; Torres, T. "Role of Structural Factors in the Nonlinear Optical Properties of Phthalocyanines and Related Compounds" *Chem. Rev.* 104 (2004): 3723-3750.
- [15] Rothmund, P. "Formation of Porphyrins from Pyrrole and Aldehydes" *J. Am. Chem. Soc.* 57 (1935): 2010-2011.
- [16] Adler, A. D.; Longo, F. R.; Finarelli, J. D.; Goldmacher, J.; Assour, J.; Korsakoff, L. "A Simplified Synthesis for *meso*-Tetraphenylporphine" *J. Org. Chem.* 32 (1967): 476.
- [17] Lindsey, J. S.; Schreiman, I. C.; Hsu, H. C.; Kearney, P. C.; Marguerettaz, A. M. "Rothermund and Adler-Longo Reactions Revisited: Synthesis of Tetraphenyl Porphyrins under Equilibrium Conditions" *J. Org. Chem.* 52 (1987): 827-836.
- [18] Sessler, J. L.; Mozaffari, A.; Johnson, M. R. "3,4-Diethylpyrrole and 2,3,7,8,12,13,17,18-Octaethylporphyrin" *Org. Synth.* 70 (1991): 68-77.
- [19] Whitlock, H. W.; Hanauer, Jr. R. "Octaethylporphyrin" *J. Org. Chem.* 33 (1968): 2169-2171.
- [20] Gryko, D.; Lindsey, J. S. "Rational Synthesis of *meso*-Substituted Porphyrins Bearing One Nitrogen Heterocyclic Group" *J. Org. Chem.* 65 (2000): 2249-2252.
- [21] Arsenault, G. P.; Bullock, E.; MacDonald, S. F. "Pyrromethanes and Porphyrins Therefrom" *J. Am. Chem. Soc.* 82 (1960): 4384-4389.
- [22] Burrell, A. K.; Officer, D. L.; Plieger, P. G.; Reid, D. C. W. "Synthetic Routes to Multiporphyrin Arrays" *Chem. Rev.* 101 (2001): 2751-2796.
- [23] Kadish, K. M.; Smith, K. M.; Guillard, R. *The Porphyrin Handbook*. Boston: Academic Press, 1999.
- [24] Oth, J. F. M.; Baumann, H.; Giles, J. M.; Schroeder, G. "Radical Anion and the Dianion of [16] Annulene" *J. Am. Chem. Soc.* 94 (1972): 3498-3512.

- [25] Albert, I. D. L.; Marks, T. J.; Ratner, M. A. "Large Molecular Hyperpolarizabilities in "Push-Pull" Porphyrins. Molecular Planarity and Auxiliary Donor-Acceptor Effects" *Chem. Mater.* 10 (1998): 753-762.
- [26] Reimers, J. R.; Lue, T. X.; Crossley, M. J.; Hush, N. S. "The Mechanism of Inner-Hydrogen Migration in Free Base Porphyrin: Ab Initio MP2 Calculations" *J. Am. Chem. Soc.* 117 (1995): 2855-2861.
- [27] Naruta, Y.; Tani, F.; Maruyama, K. "*meso*-Perfluorination of Porphyrins with *N*-Fluoropyridinium Triflate" *Tetrahedron Lett.* 33 (1992): 1069-1072.
- [28] Ali, H.; van Lier, J. E. "Phenylselenenyl Halides: Efficient Reagents for the Selective Halogenation and Nitration of Porphyrins" *Tetrahedron Lett.* 32 (1991): 5015-5018.
- [29] Dimagno, S. G.; Lin, V. S. Y.; Therien, M. J. "Facile Elaboration of Porphyrins *via* Metal-Mediated Cross-Coupling" *J. Org. Chem.* 58 (1993): 5983-5993.
- [30] Jaquinod, L.; Khoury, R. G.; Shea, K. M.; Smith, K. M. "Regioselective Syntheses and Structural Characterizations of 2,3-Dibromo- and 2,3,7,8,12,13-Hexabromo-5,10,15,20-tetraphenylporphyrins" *Tetrahedron* 55 (1999): 13151-13158.
- [31] Boyle, R. W.; Johnson, C. K.; Dolphin, D. "Iodination and Heck Alkynylation of 5,15-Diphenylporphyrin. A Convenient Entry to Asymmetrically *meso*-Substituted Porphyrins" *J. Chem. Soc., Chem. Commun.* (1995): 527-528.
- [32] Vicente, M. G. H.; Smith, K. M. "Porphyrins and Derivatives: Synthetic Strategies and Reactivity Profiles" *Curr. Org. Chem.* 4 (2000): 139-174.
- [33] Shea, K. M.; Jaquinod, L.; Smith, K. M. "Dihydroporphyrin Synthesis: New Methodology" *J. Org. Chem.* 63 (1998): 7013-7021.
- [34] Chang, C. K.; Sotiriou, C. "*C*-Hydroxy- and *C*-Methylchlorins. A Convenient Route to Heme *d* and Bonellin Model Compounds" *J. Org. Chem.* 50 (1985): 4989-4991.
- [35] Stolzenberg, A. M.; Simerly, S. W.; Steffey, B. D.; Haymond, G. C. "The Synthesis, Properties, and Reactivities of Free-Base- and Zn(II)-*N*-Methyl Dihydroporphyrin Compounds. The Unexpected Selectivity of the Direct Methylation of Free-Base Dihydroporphyrin Compounds" *J. Am. Chem. Soc.* 119 (1997): 11843-11854.

- [36] Falk, J. E. *Porphyrins and Metalloporphyrins*. New York: Elsevier, 1975.
- [37] Biesaga, M.; Pyrzynska, K.; Trojanowicz, M. "Porphyrins in Analytical Chemistry. A Review" *Talanta* 51 (2000): 209-224.
- [38] Adler, A. D.; Longo, F. R.; Kampas, F.; Kim, J. "On the Preparation of Metalloporphyrins" *J. Inorg. Nucl. Chem.* 2 (1970): 2443-2445.
- [39] Anderson, H. L. "Building Molecular Wires from the Colours of Life: Conjugated Porphyrin Oligomers" *Chem. Commun.* (1999): 2323-2330.
- [40] Zheng, W.; Shan, N.; Yu, L.; Wang, X. "UV-Visible, Fluorescence and EPR Properties of Porphyrins and Metalloporphyrins" *Dyes Pigments* 77 (2008): 153-157.
- [41] Lukas, A. S.; Bushard, P. J.; Wasielewski, M. R. "Electron Transfer Involving Nonbonded Superexchange Interactions in Rigid Donor-Acceptor Arrays" *J. Phys. Chem. A* 106 (2002): 2074-2082.
- [42] Hayashi, N.; Sato, M.; Miyabayashi, K.; Miyake, M.; Higuchi, H. "Synthesis and Electronic Properties of Trimeric Octaethylporphyrin (OEP) Derivative Connected with Diacetylene Linkage. A Comparative Study with Vinylene-Group Connected OEP Trimer" *Sci. Technol. Adv. Mater.* 7 (2006): 237-242.
- [43] Osuka, A.; Tanabe, N.; Nakajima, S.; Maruyama, K. "Synthesis of 1,4-Phenylene-Bridged Linear Porphyrin Arrays" *J. Chem. Soc., Perkin Trans. 2* (1996): 199-203.
- [44] Nakano, A.; Osuka, A.; Yamazaki, I.; Yamazaki, T.; Nishimura, Y. "Windmill-Like Porphyrin Arrays as Potent Light-Harvesting Antenna Complexes" *Angew. Chem., Int. Ed.* 37 (1998): 3023-3027.
- [45] Seth, J.; Palaniappan, V.; Johnson, T. E.; Prathapan, S.; Lindsey, J. S.; Bocian D. F. "Investigation of Electronic Communication in Multi-Porphyrin Light-Harvesting Arrays" *J. Am. Chem. Soc.* 116 (1994): 10578-10592.
- [46] Screen, T. E. O.; Blake, I. M.; Rees, L. H.; Clegg, W.; Borwick, S. J.; Anderson, H. L. "Making Conjugated Connections to Porphyrins: a Comparison of Alkyne, Alkene, Imine and Azo Links" *J. Chem. Soc., Perkin Trans. 1* (2002): 320-329.
- [47] Plater, M. J.; Aiken, S.; Bourhill, G. "A New Synthetic Route to Donor-Acceptor Porphyrins" *Tetrahedron* 58 (2002): 2405-2413.

- [48] Cheng, K. L.; Li, H. W.; Ng, D. K. P. "Synthesis and Characterization of *meso*-Ferrocenylethynyl 5,15-Diphenylporphyrins" *J. Organomet. Chem.* 689 (2004): 1593-1598.
- [49] Zhang, T. G.; Zhao, Y. X.; Asselberghs, I.; Persoons, A.; Clays, K.; Therien, M. J. "Design, Synthesis, Linear, and Nonlinear Optical Properties of Conjugated (Porphinato)zinc(II)-Based Donor-Acceptor Chromophores Featuring Nitrothiophenyl and Nitrooligothiophenyl Electron-Accepting Moieties" *J. Am. Chem. Soc.* 127 (2005): 9710-9720.
- [50] Zhang, T. G.; Zhao, Y. X.; Song, K.; Asselberghs, I.; Persoons, A.; Clays, K.; Therien, M. J. "Electronic modulation of hyperpolarizable (porphinato)zinc(II) chromophores featuring ethynylphenyl-, ethynylthiophenyl-, ethynylthiazolyl-, and ethynylbenzothiazolyl-based electron-donating and -accepting moieties" *Inorg. Chem.* 45 (2006): 9703-9712.
- [51] Lembo, A.; Tagliatesta, P.; Guldi, D. M.; Wielopolski, M.; Nuccetelli, M. "Porphyrin- β -Oligo-Ethynylene-phenylene-[60]Fullerene Triads: Synthesis and Electrochemical and Photophysical Characterization of the New Porphyrin-Oligo-PPE-[60]Fullerene Systems" *J. Phys. Chem. A* 113 (2009): 1779-1793.
- [52] Lin, V. S.-Y.; Therien, M. J. "The Role of Steric and Electronic Effects in the Extensive Modulation of the Absorptive and Emissive Properties of a Steric of Ethynyl- and Butadiynyl-Bridged Bis- and Tris-Porphinato(zinc) Chromophores" *Chem. Eur. J.* 1 (1995): 645-651.
- [53] Littler, B. J.; Miller, M. A.; Hung, C. H.; Wagner, R. W.; O'Shea, D. F.; Boyle, P. D.; Lindsey, J. S. "Refined Synthesis of 5-Substituted Dipyrromethanes" *J. Org. Chem.* 64 (1999): 1391-1396.
- [54] Leonard, K. A.; Nelen, M. I.; Anderson, L. T.; Gibson, S. L.; Hilf, R.; Detty, M. R. "2,4,6-Triarylchalcogenopyrylium Dyes Related in Structure to the Antitumor Agent AA1 as in Vitro Sensitizers for the Photodynamic Therapy of Cancer" *J. Med. Chem.* 42 (1999): 3942-3952.
- [55] Miki, Y.; Momotake, A.; Arai, T. "The Photochemical Characteristics of Aromatic Eneidyne Compounds Substituted with Electron Donating and Electron Withdrawing Groups" *Org. Biomol. Chem.* 1 (2003): 2655-2660.

- [56] Richardson, C.; Reed, C. A. "Synthesis of *meso*-Extended Tetraarylporphyrins" *J. Org. Chem.* 72 (2007): 4750-4755.
- [57] Laha, J. K.; Dhanalekshmi, S.; Taniguchi, M.; Ambroise, A.; Lindsey, J. S. "A Scalable Synthesis of *meso*-Substituted Dipyrromethanes" *Org. Proc. Res. Dev.* 7 (2003): 799-812.
- [58] Thamyongkit, P.; Speckbacher, M.; Diers, J. R.; Kee, H. L.; Kirmaier, C.; Holten, D.; Bocian, D. F.; Lindsey, J. S. "Swallowtail Porphyrins: Synthesis, Characterization and Incorporation into Porphyrin Dyads" *J. Org. Chem.* 69 (2004): 3700-3710.
- [59] Lindsey, J. S.; Schreiman, I. C.; Hsu, H. C.; Kearney, P. C.; Marguerettaz, A. M. "Rothemund and Adler-Longo Reactions Revisited: Synthesis of Tetraphenylporphyrins under Equilibrium Conditions" *J. Org. Chem.* 52 (1987): 827-836.
- [60] Tabushi, I.; Sakai, K.; Yamamura, K. "Biomimetic One-Step Cyclooligomerization to *meso*-Tetraalkylporphyrins by Use of Schiff's Bases" *Tetrahedron Lett.* 19 (1978): 1821-1824.
- [61] Onaka, M.; Shinoda, T.; Izumi, Y.; Nolen, E. "Clay-Mediated *meso*-Tetraarylporphyrin Synthesis" *Tetrahedron Lett.* 34 (1993): 2625-2628.
- [62] Chabdon-Noblat, S.; Sauvage, J.-P. "Synthesis of bis-Porphyrins Containing a 2,9-Diphenyl-1,10-phenanthroline Spacer" *Tetrahedron* 47 (1991): 5123-5132.
- [63] Spence, J. D.; Lash, T. D. "Porphyrins with Exocyclic Rings. 14. - Synthesis of Tetraacenaphthoporphyrins, a New Family of Highly Conjugated Porphyrins with Record-Breaking Long-Wavelength Electronic Absorptions" *J. Org. Chem.* 65 (2000): 1530-1539.
- [64] Arunwattanachok, T. *Synthesis of Pyridylporphyrin Metal Complexes*. Master's Thesis. Petrochemistry and Polymer Science Program, Faculty of Science, Chulalongkorn University, 2006.
- [65] Barbosa Neto, N. M.; Oliveira, S. L.; Guedes, I.; Dinelli, L. R.; Misoguti, L.; Mendonca, C. R.; Batista, A. A.; Zilio, S. C. "Reverse Saturable Absorption in 5,10,15,20-Tetra(4-pyridyl)-21H,23H-porphyrin with Ruthenium Outlying Complexes" *J. Braz. Chem. Soc.* 17 (2006): 1377-1382.

- [66] Sun, X. D.; Chen, G. D.; Zhang, J. L. "The Photophysical Properties of Metal Complexes of Fluorescein-Porphyrin" *Dyads. Dyes Pigments* 76 (2008): 499-501.
- [67] Fletcher, D. A.; McMeeking, R. F.; Parkin, D. "The United Kingdom Chemical Database. Service" *J. Chem. Inf. Comput. Sci.* 36 (1996): 746-749.
- [68] Huang, T. H.; Chen, Y. J.; Lo, S. S.; Yen, W. N.; Mai, C. L.; Kuo, M. C.; Yeh, C. Y. "Highly Conjugated Multiporphyrins: Synthesis, Spectroscopic and Electrochemical Properties" *Dalton Trans.* (2006): 2207-2213.
- [69] Sugiura, K.; Fujimoto, Y.; Sakata, Y. "A Porphyrin Square: Synthesis of a Square-Shaped π -Conjugated Porphyrin Tetramer Connected by Diacetylene Linkages" *Chem Commun.* (2000): 1105-1106.
- [70] D'Amico, A.; Di Natale, C.; Paolesse, R.; Macagnano, A.; Mantini, A. "Metalloporphyrins as Basic Material for Volatile Sensitive Sensors" *Sensors and Actuators B* 65 (2000): 209-215.
- [71] Akrajas; Salleh, M. M.; Yahaya, M. "Enriching the Selectivity of Metalloporphyrins Chemical Sensors by Means of Optical Technique" *Sensors and Actuators B* 85 (2002): 191-196.
- [72] Brittle, S. A.; Richardson, T. H.; Hutchinson, J.; Hunter, C. A. "Comparing Zinc and Manganese Porphyrin LB Films as Amine Vapour Sensing Materials" *Colloids and Surfaces A: Physicochem. Eng. Aspects* 321 (2008): 29-33.
- [73] Harriman, A.; Sauvage, J. P. "Strategy for Constructing Photosynthetic Models: Porphyrin-Containing Modules Assembled Around Transition Metals" *Chem. Soc. Rev.* 25 (1996): 41-48.
- [74] Screen, T. E. O.; Thorne, J. R. G.; Denning, R. G.; Bucknall, D. G.; Anderson, H. L. "Two Methods for Amplifying the Optical Nonlinearity of a Conjugated Porphyrin Polymer: Transmetallation and Sself-Assembly" *J. Mater. Chem.* 13 (2003): 2796-2808.
- [75] Liu, Z. B.; Tian, J. G.; Zheng, J. Y.; Li, Z. Y.; Chen, S. Q.; Zhu, Y. "Active Tuning of Nonlinear Absorption in a Supramolecular Zinc Diphenylporphyrin-Pyridine System" *Opt. Exp.* 14 (2006): 2770-2775.

- [76] Bhyrappa, P.; Krishnan, V.; Nethaji, M. "Solvation and Axial Ligation Properties of (2,3,7,8,12,13,17,18-Octabromo-5,10,15,20-tetraphenylporphyrinato)zinc(II)" *J. Chem. Soc. Dalton Trans.* (1993): 1901-1906.

APPENDICES

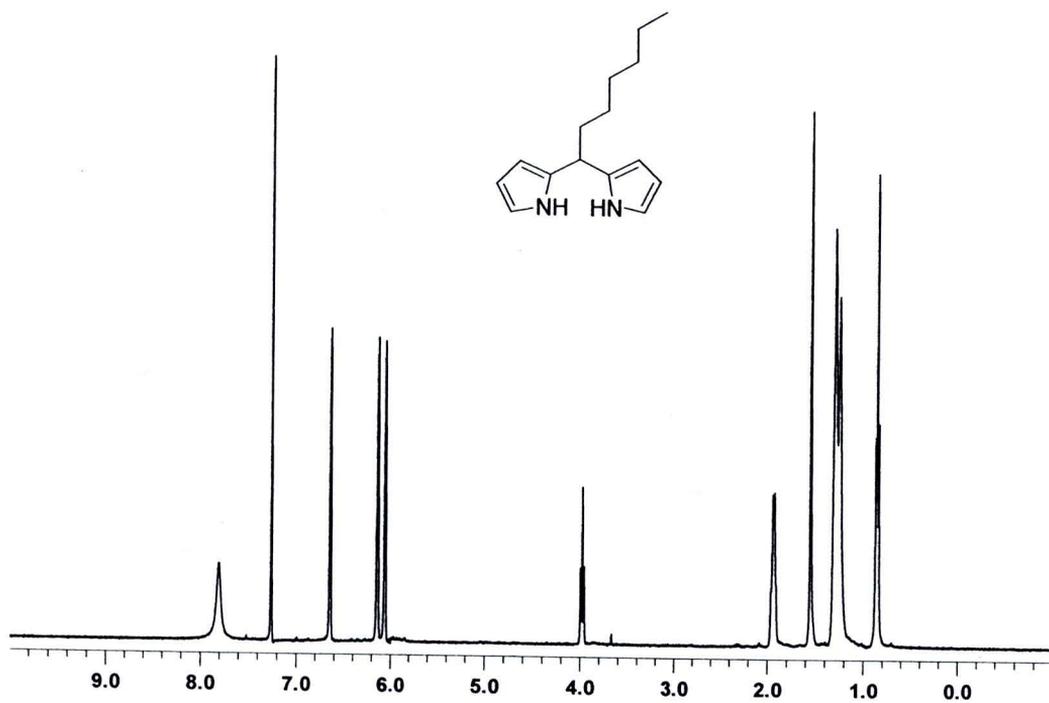


Figure A-1 The ^1H NMR spectrum of 5-hexyldipyrromethane (1)

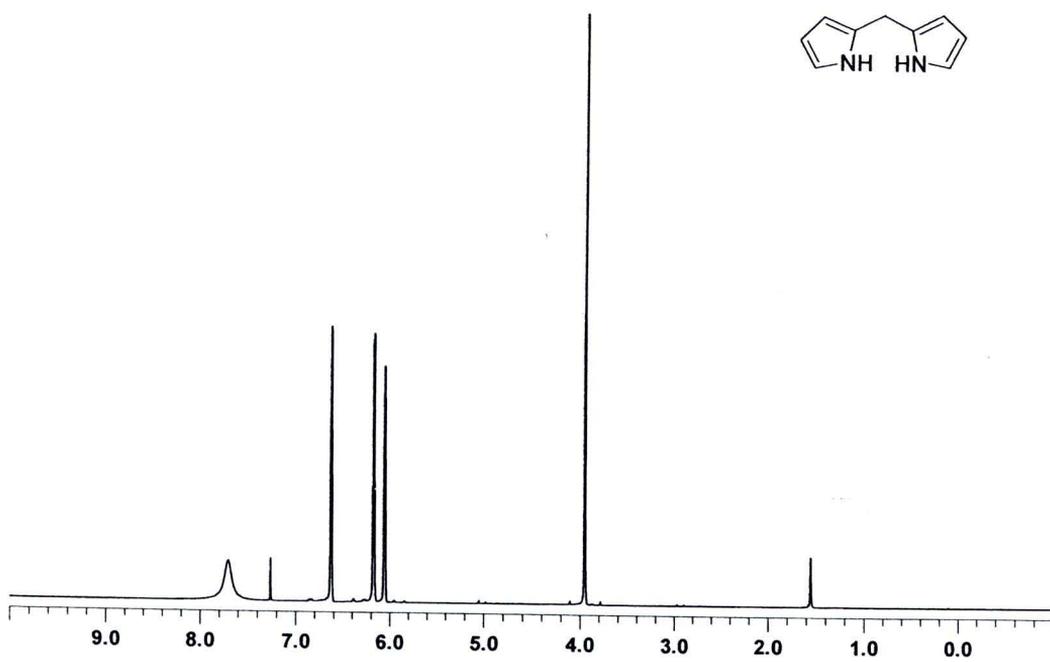


Figure A-2 The ^1H NMR spectrum of dipyrromethane (2)

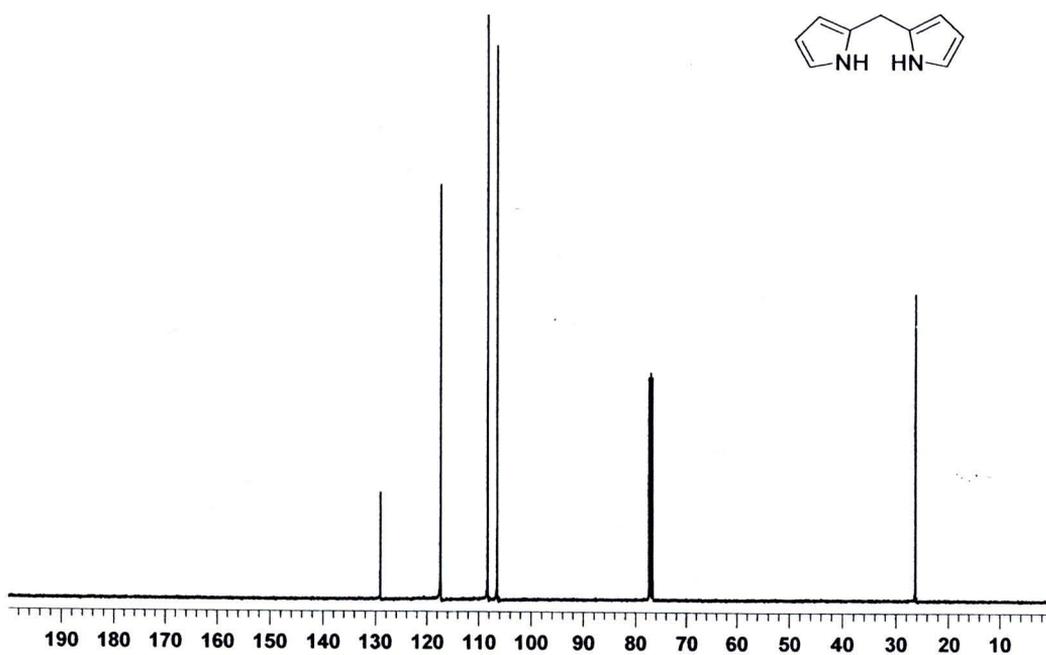


Figure A-3 The ^{13}C NMR spectrum of dipyrromethane (2)

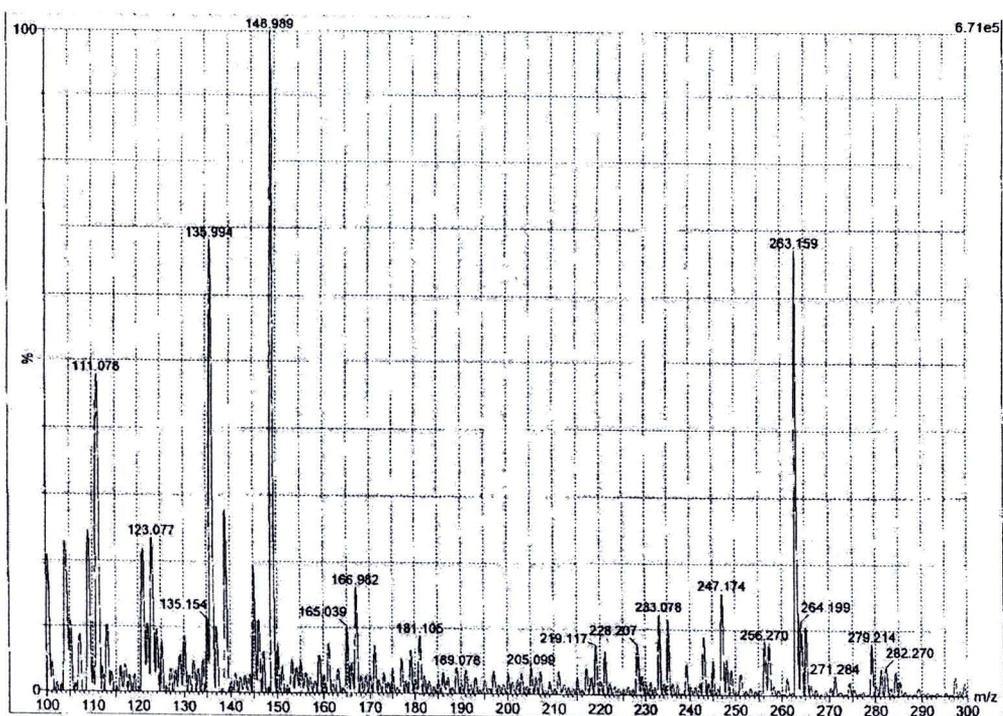


Figure A-4 The ESI mass spectrum of dipyrromethane (2)

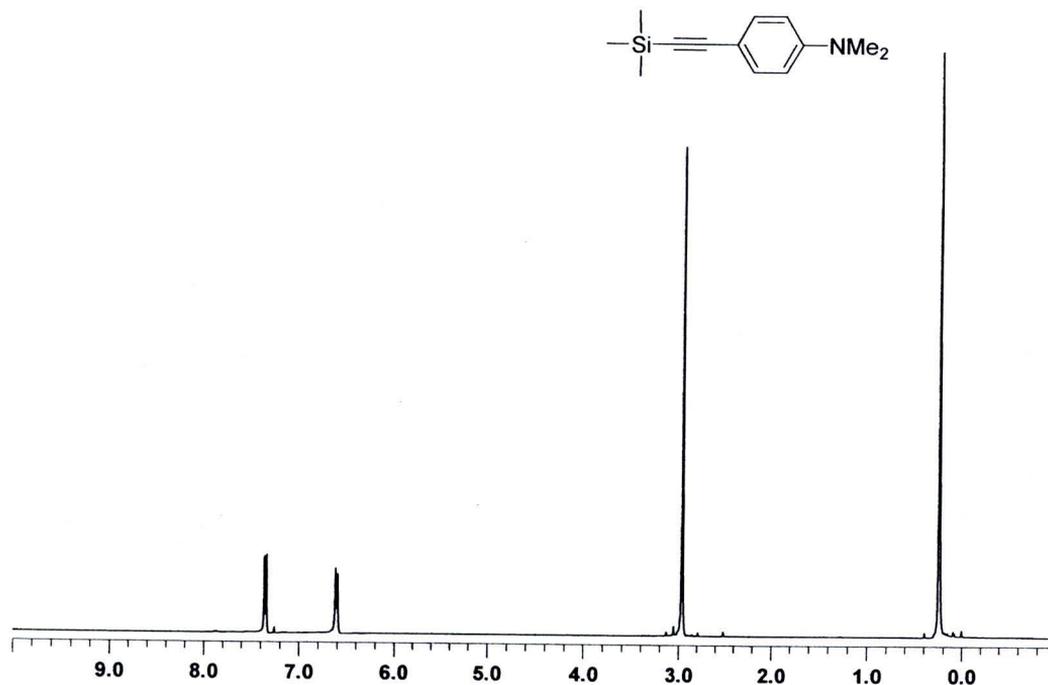


Figure A-5 The ¹H NMR spectrum of DMAP-TMSE (3)

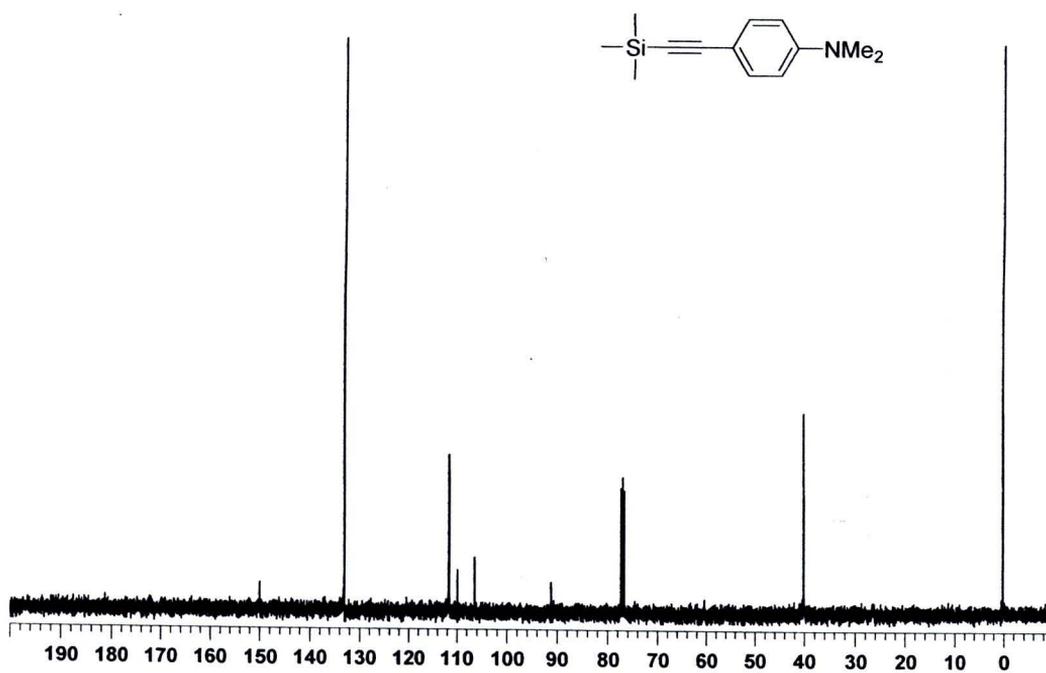


Figure A-6 The ¹³C NMR spectrum of DMAP-TMSE (3)

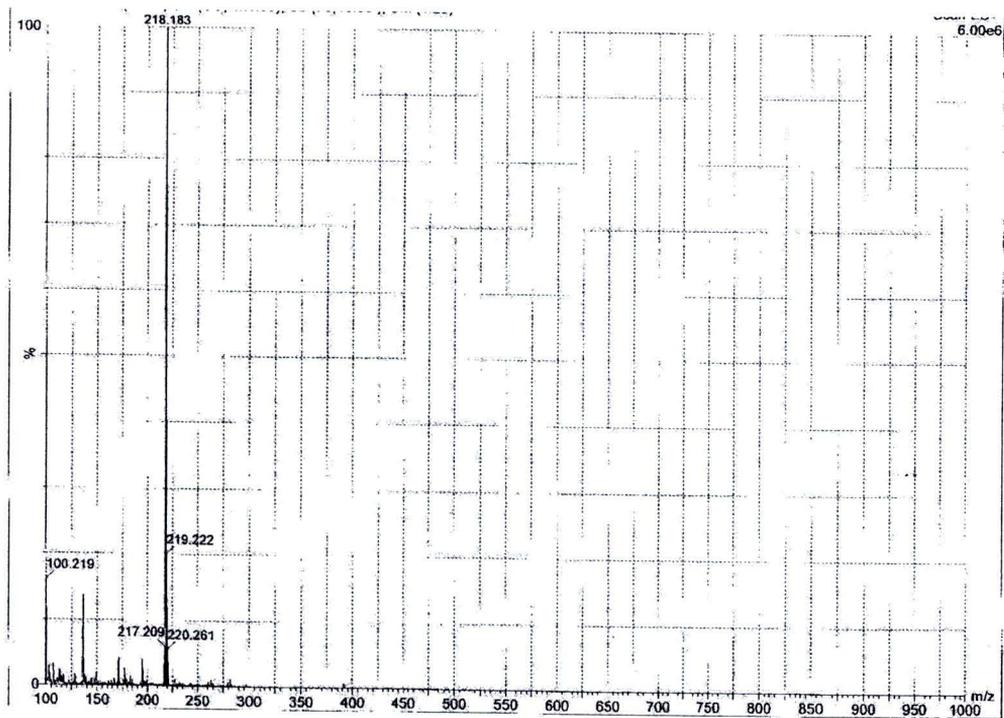


Figure A-7 The ESI mass spectrum of DMAP-TMSE (3)

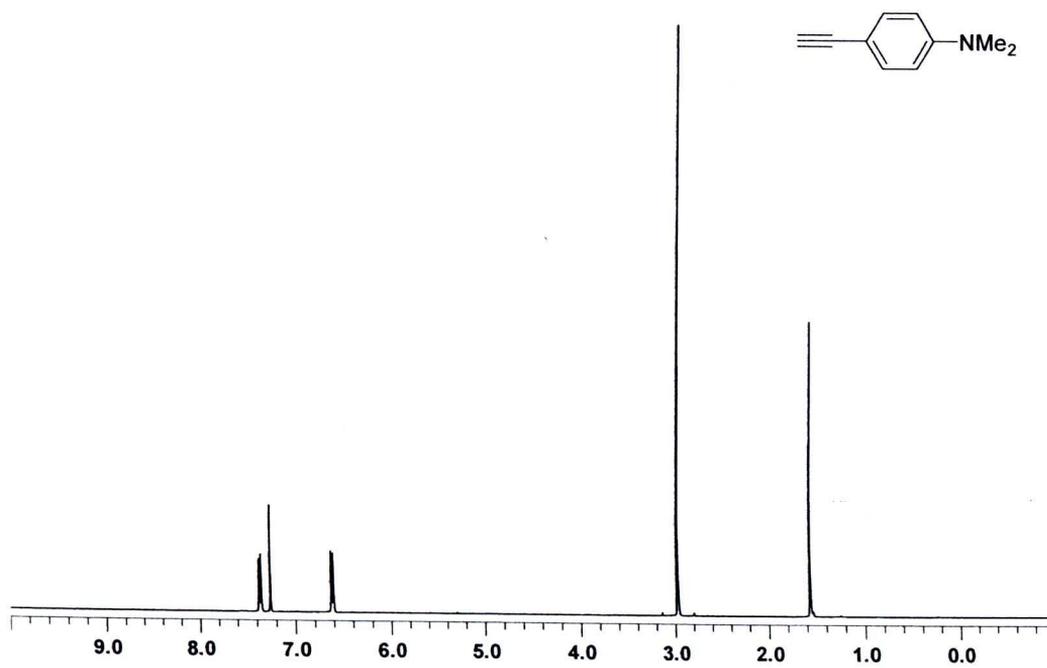


Figure A-8 The ^1H NMR spectrum of DMAPE (4)

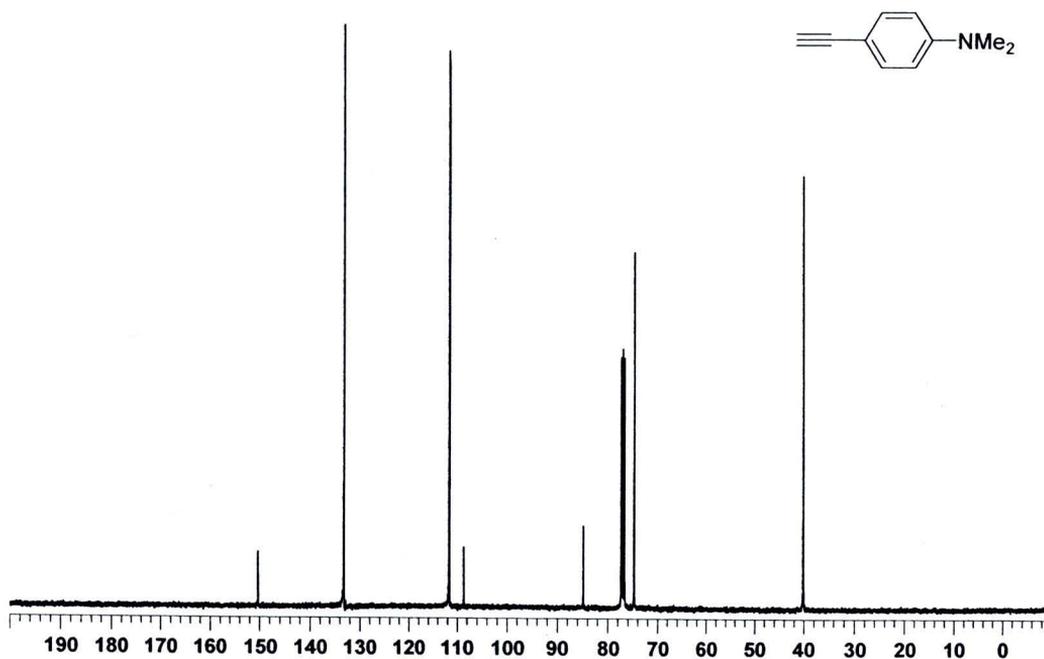


Figure A-9 The ^{13}C NMR spectrum of DMAPE (4)

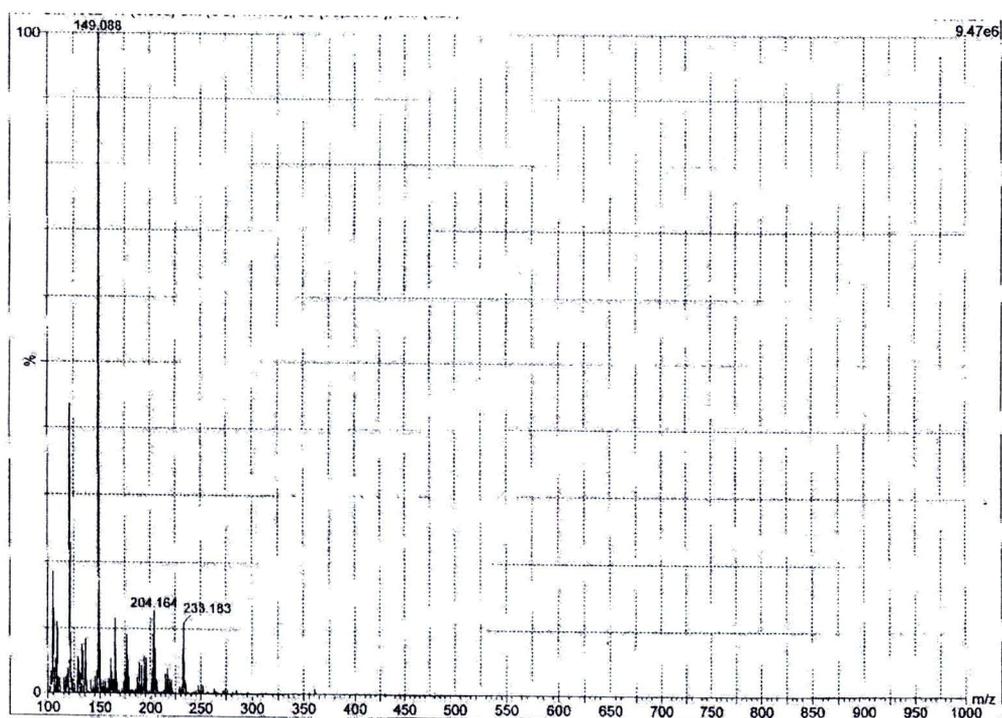


Figure A-10 The ESI mass spectrum of DMAPE (4)

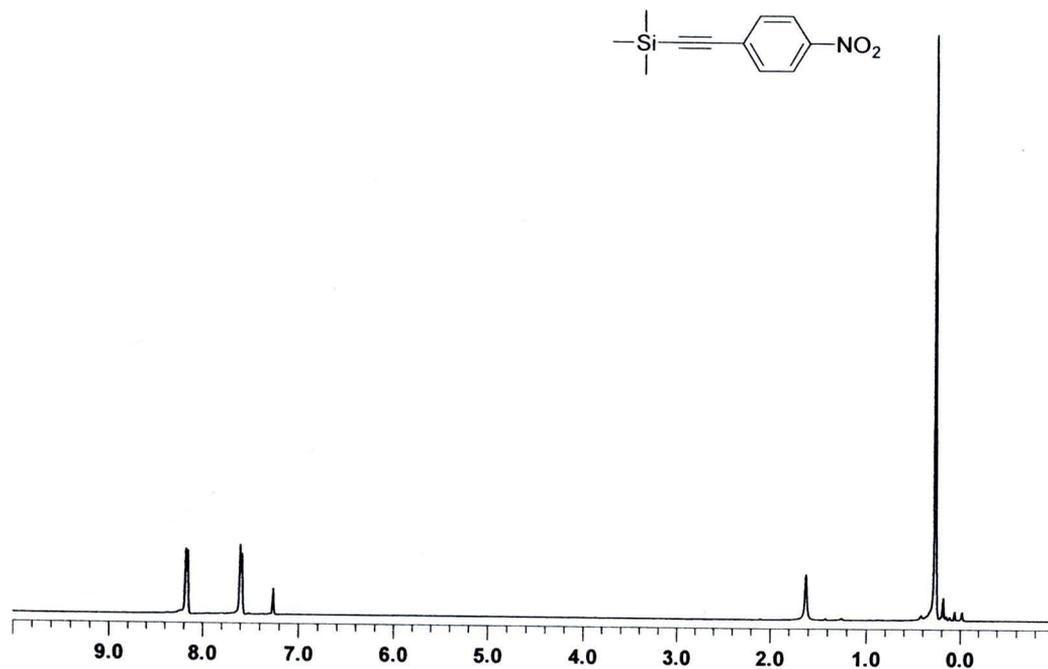


Figure A-11 The ^1H NMR spectrum of NP-TMSE (5)

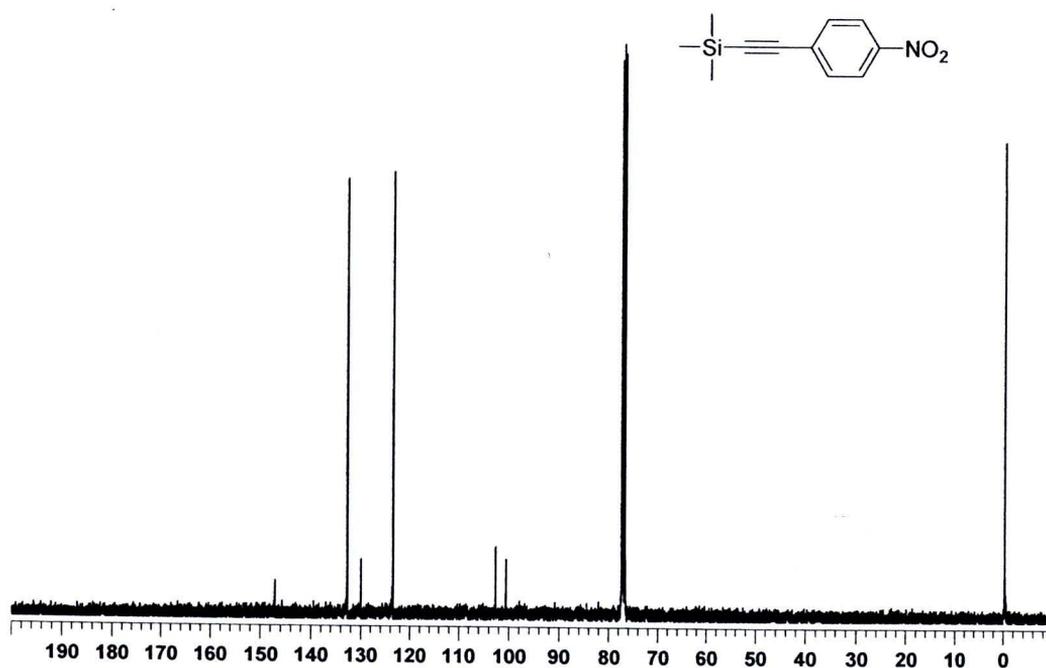


Figure A-12 The ^{13}C NMR spectrum of NP-TMSE (5)

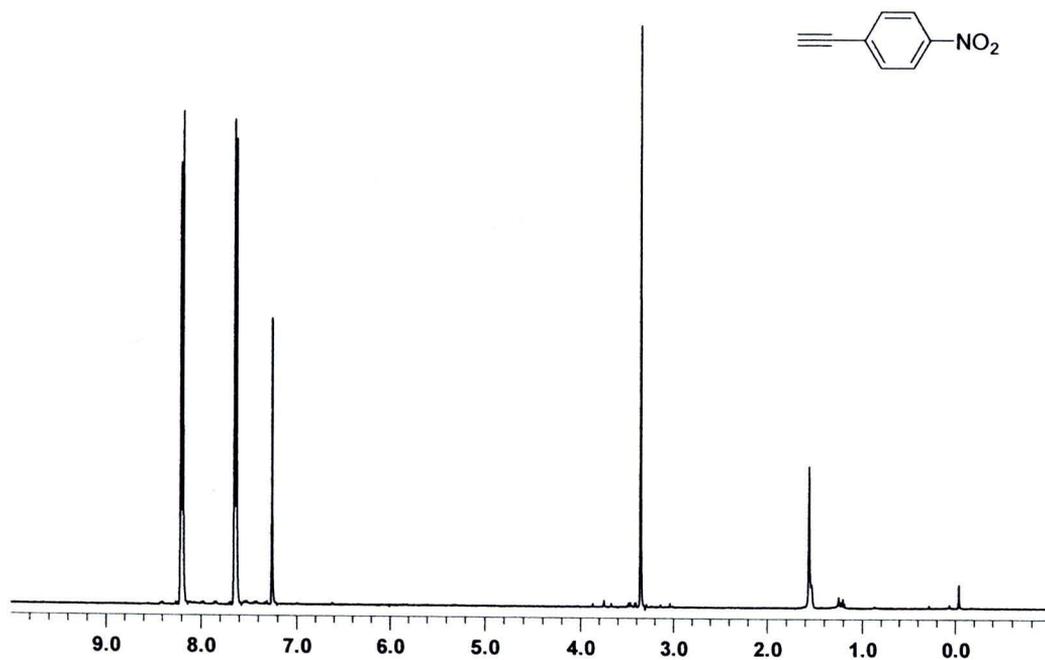


Figure A-13 The ^1H NMR spectrum of NPE (6)

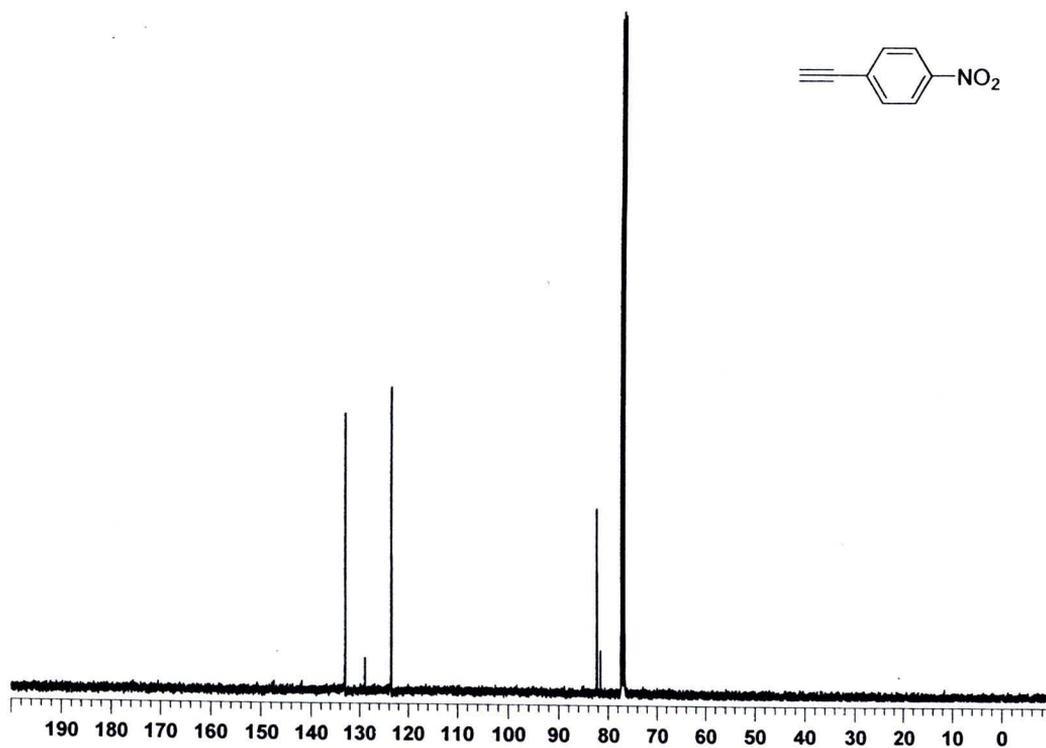


Figure A-14 The ^{13}C NMR spectrum of NPE (6)

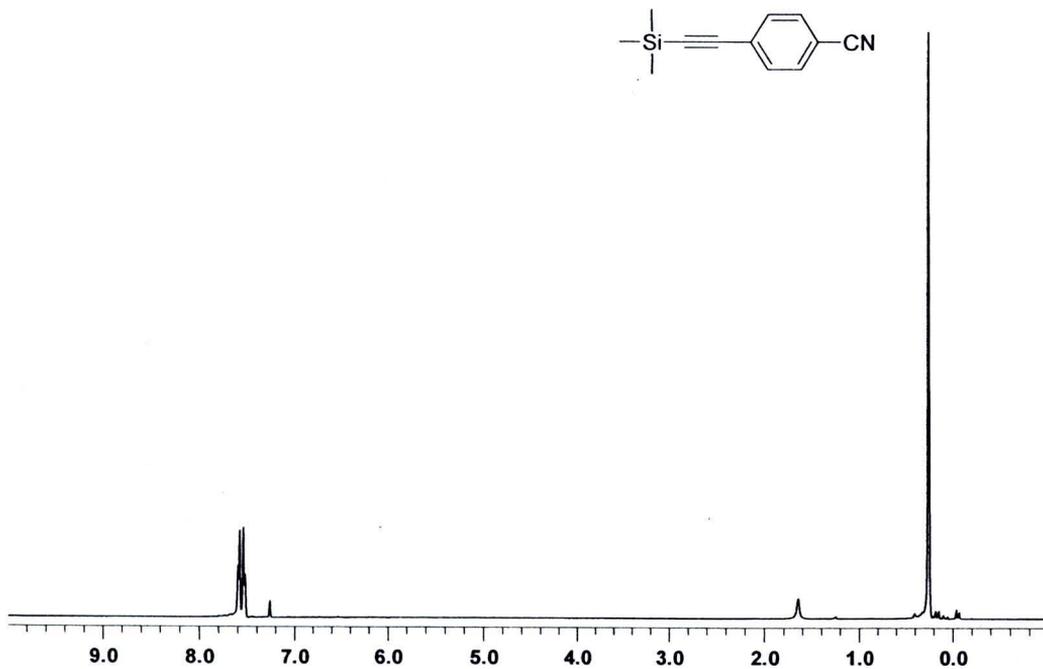


Figure A-15 The ¹H NMR spectrum of CP-TMSE (7)

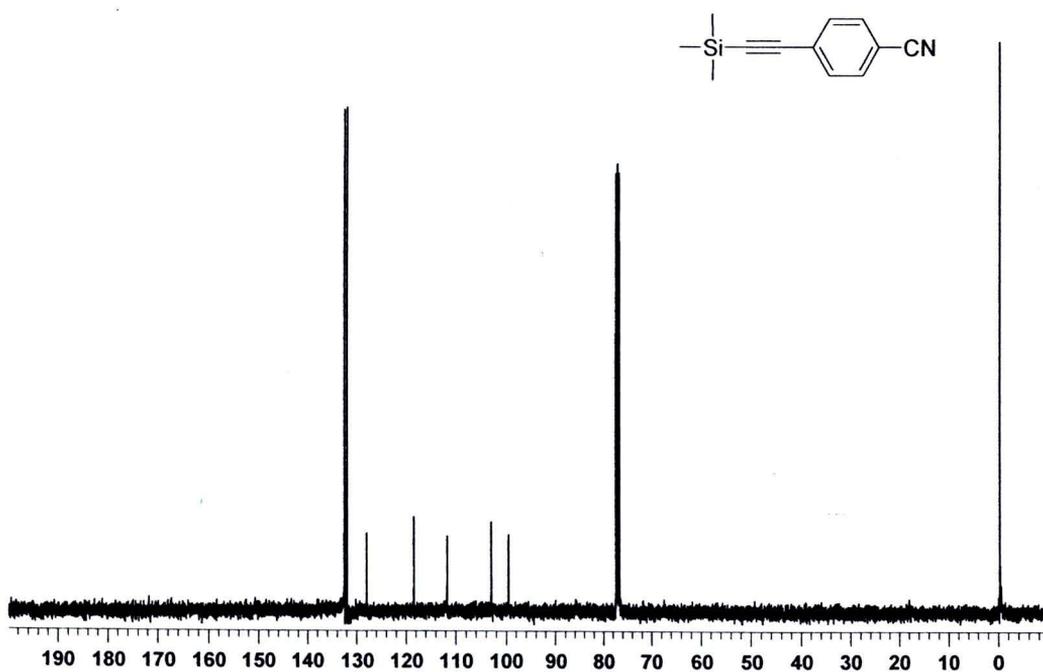


Figure A-16 The ¹³C NMR spectrum of CP-TMSE (7)

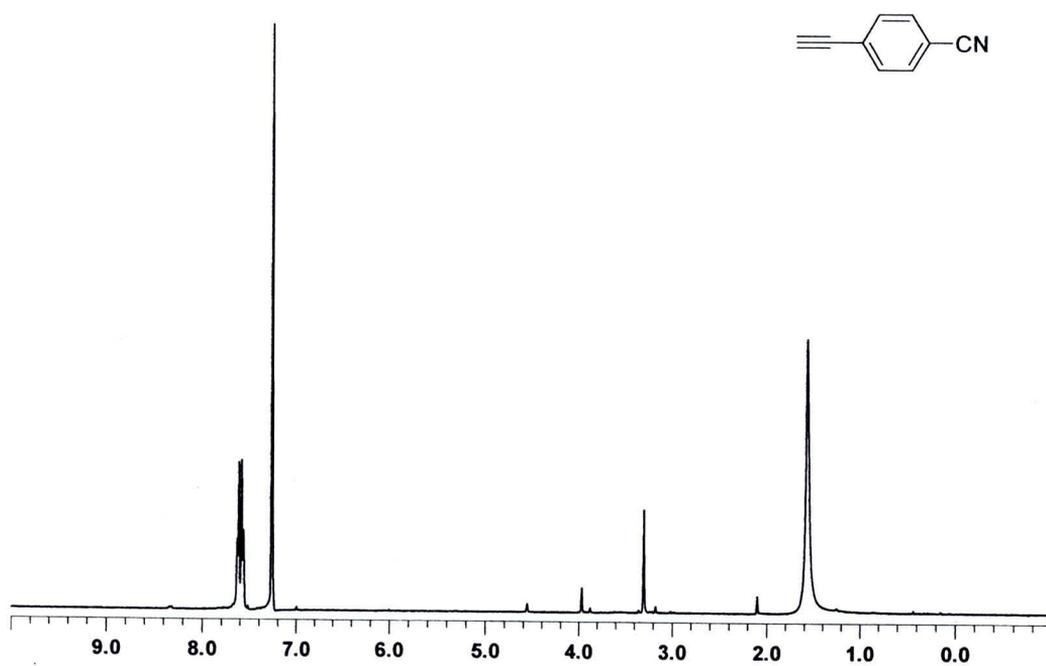


Figure A-17 The ^1H NMR spectrum of CPE (8)

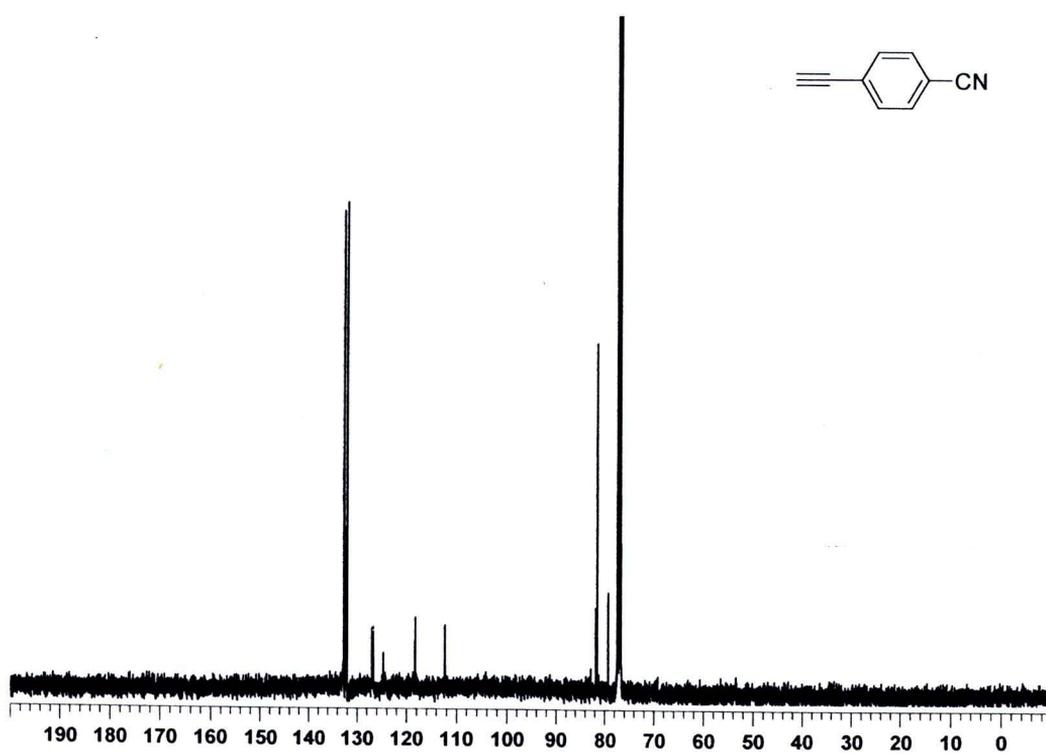


Figure A-18 The ^{13}C NMR spectrum of CPE (8)

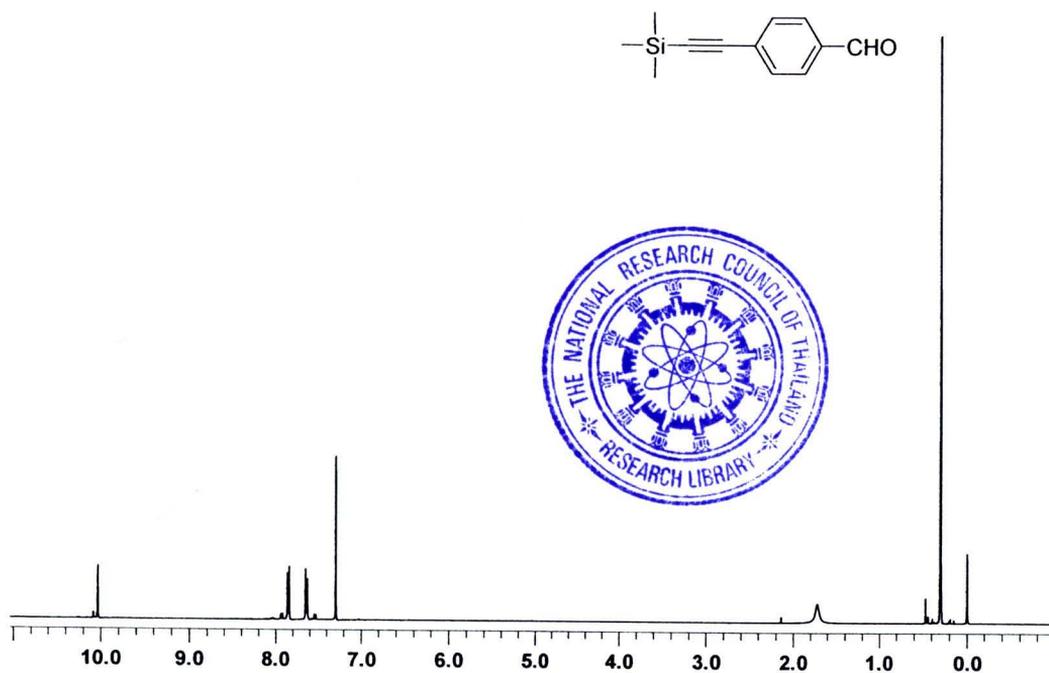


Figure A-19 The ^1H NMR spectrum of FP-TMSE (9)

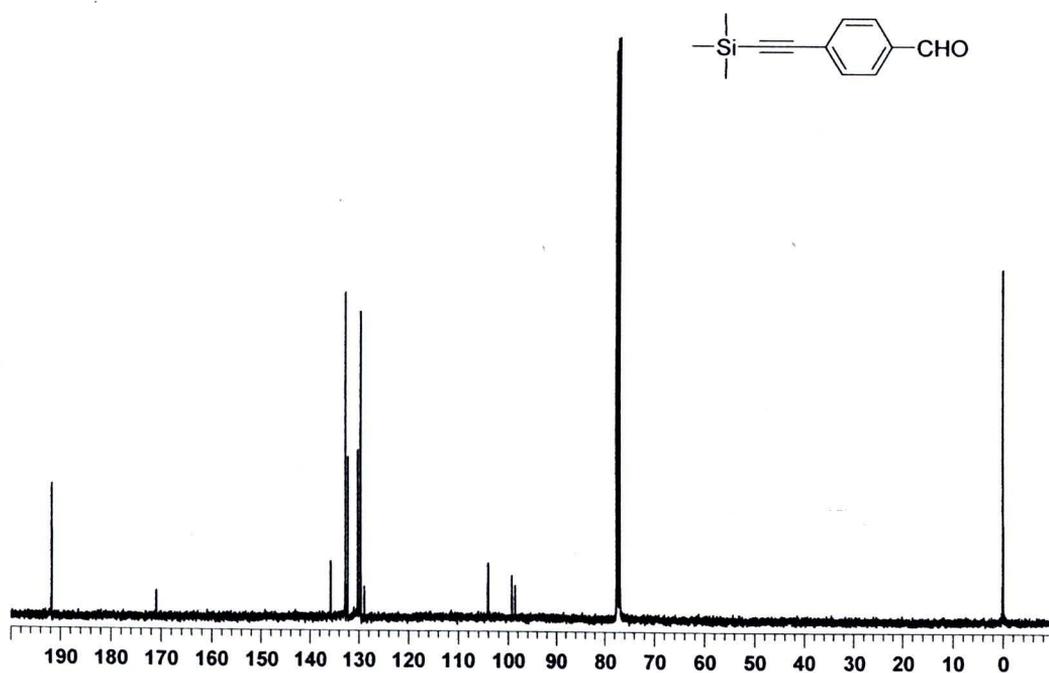


Figure A-20 The ^{13}C NMR spectrum of FP-TMSE (9)

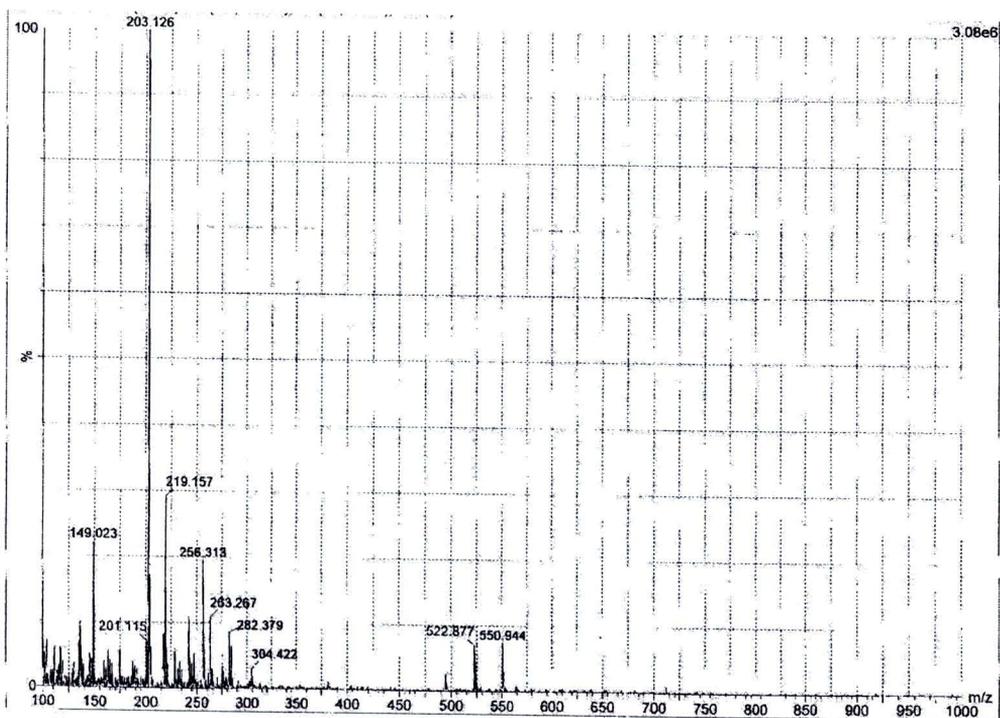


Figure A-21 The ESI mass spectrum of FP-TMSE (9)

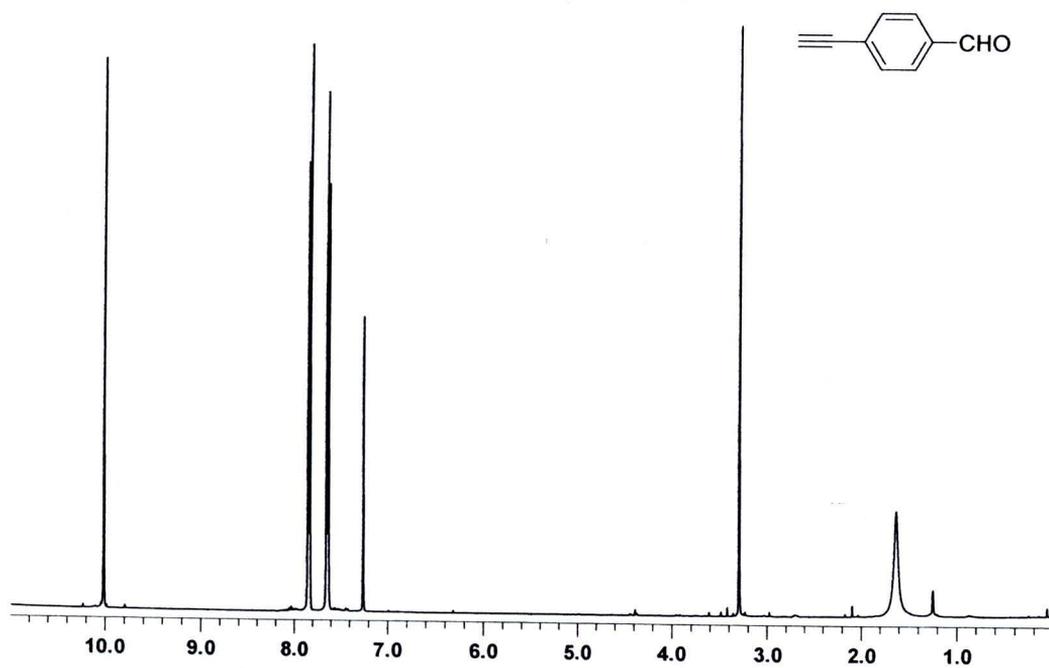


Figure A-22 The ¹H NMR spectrum of FPE (10)

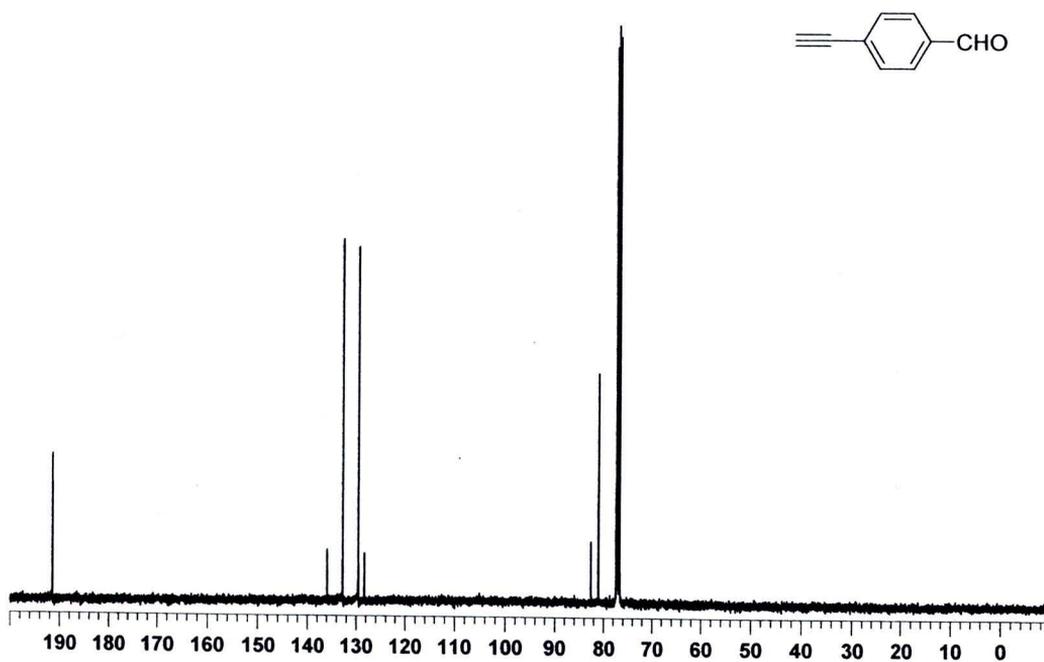


Figure A-23 The ^{13}C NMR spectrum of FPE (10)

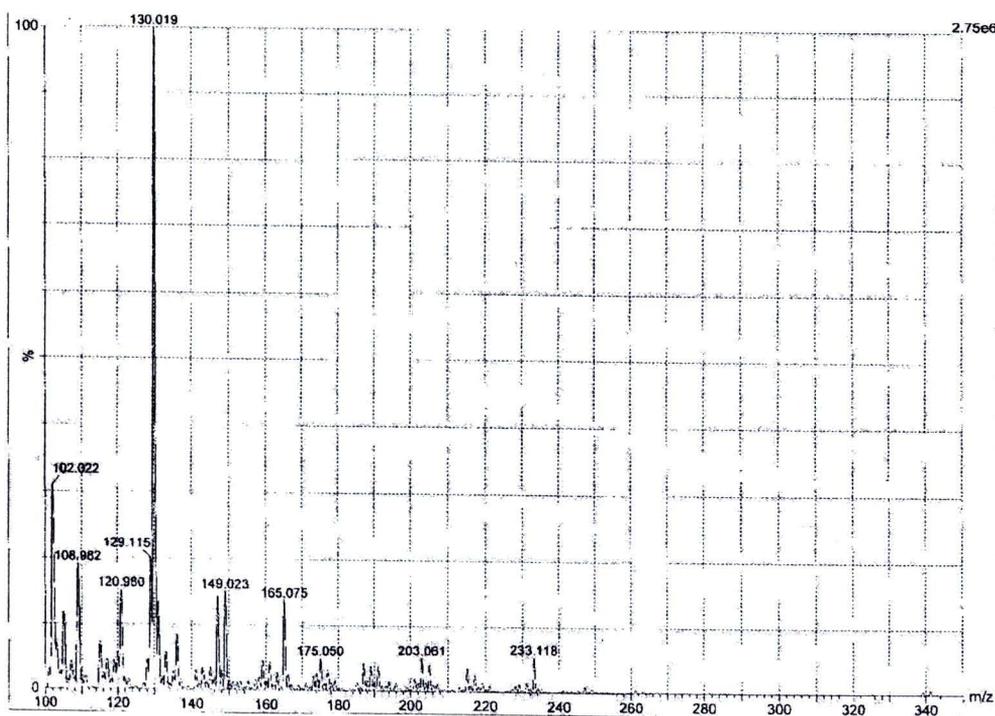


Figure A-24 The ESI mass spectrum of FPE (10)

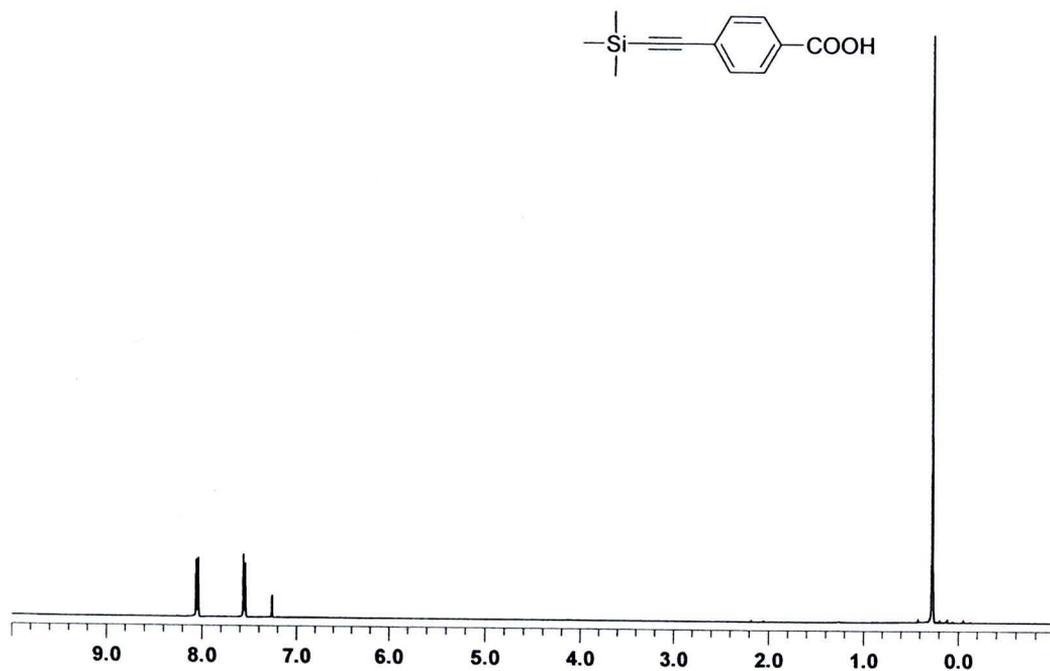


Figure A-25 The ¹H NMR spectrum of CarP-TMSE (11)

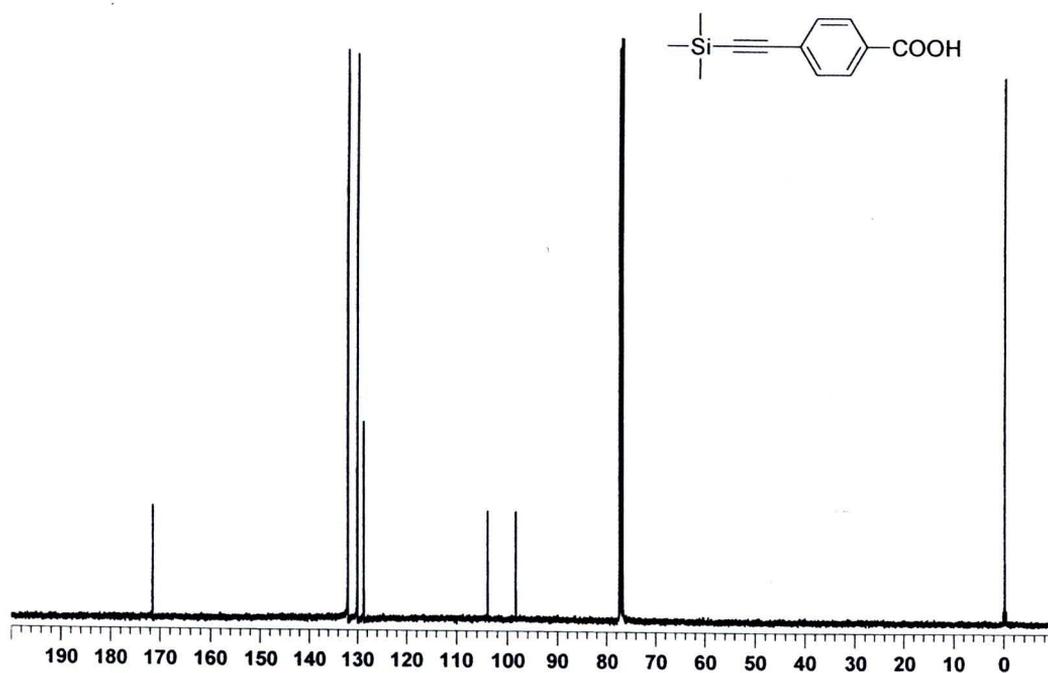


Figure A-26 The ¹³C NMR spectrum of CarP-TMSE (11)

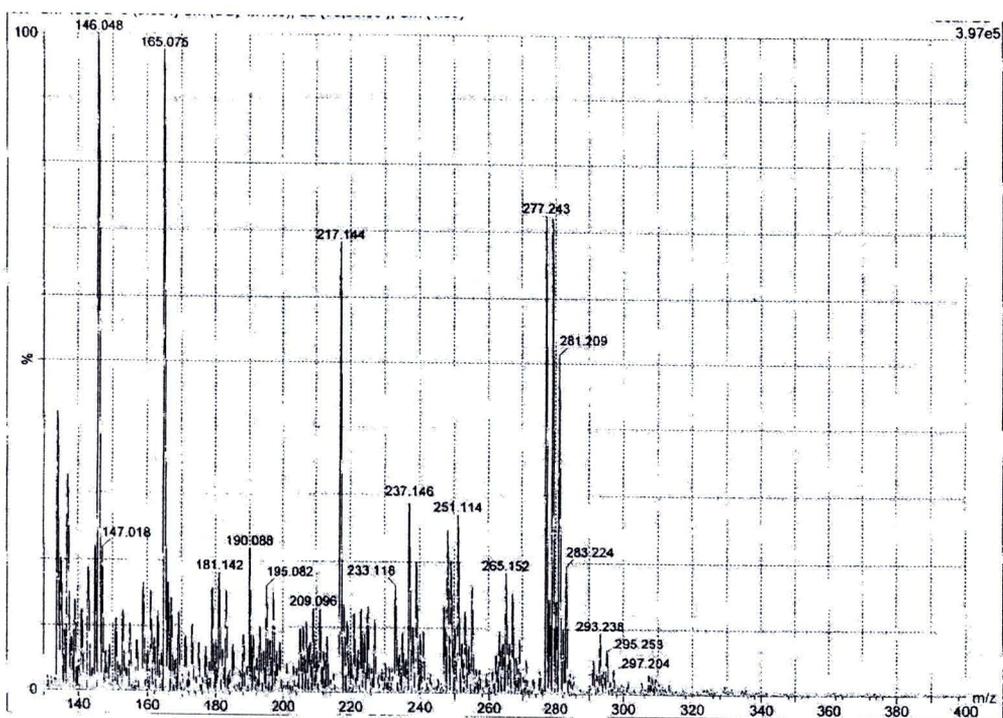


Figure A-27 The ESI mass spectrum of CarP-TMSE (11)

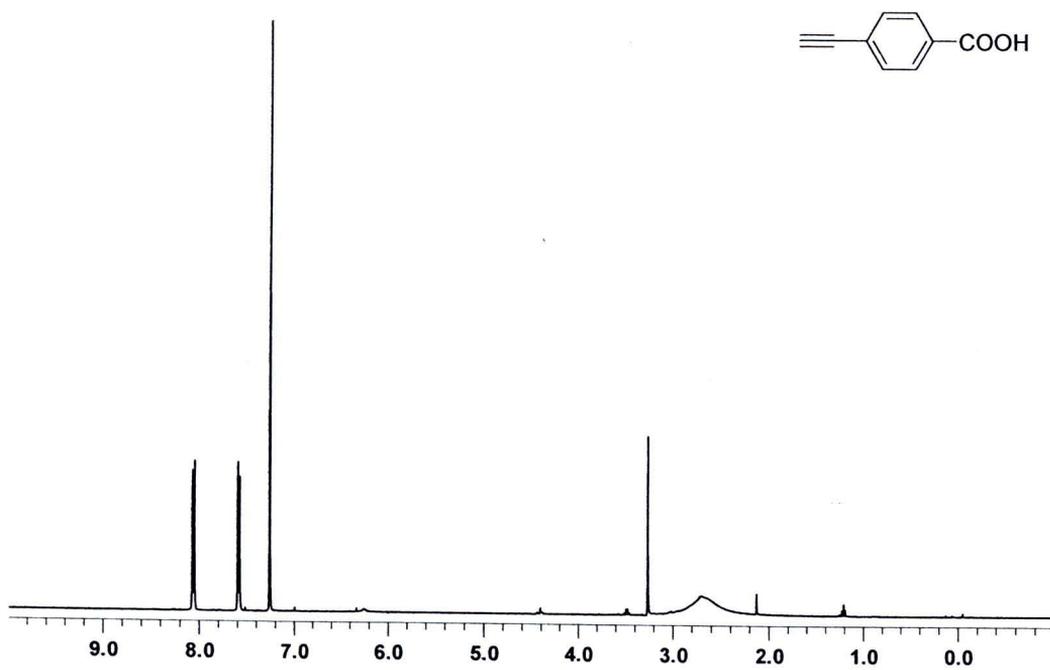


Figure A-28 The ¹H NMR spectrum of CarPE (12)

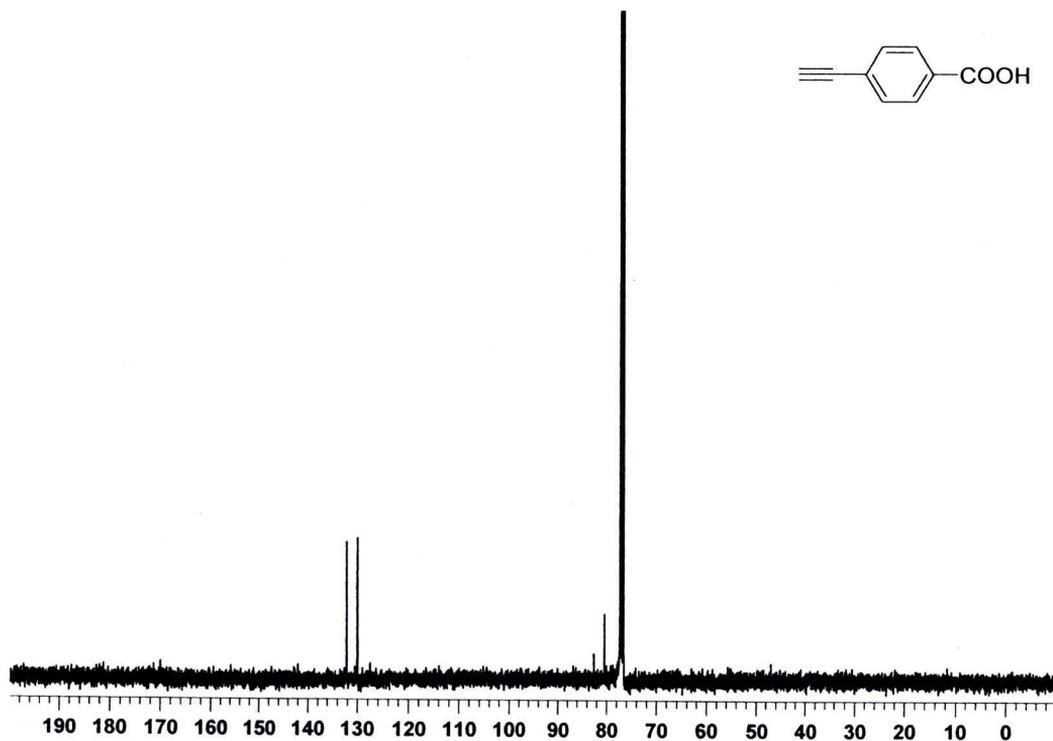


Figure A-29 The ^{13}C NMR spectrum of CarPE (12)

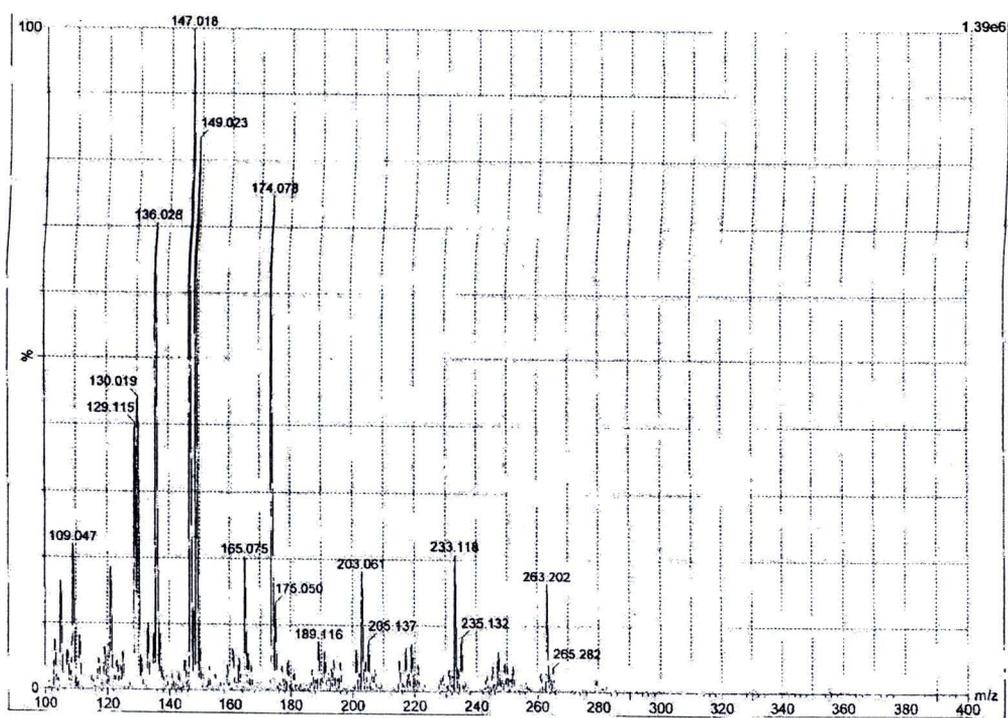


Figure A-30 The ESI mass spectrum of CarPE (12)

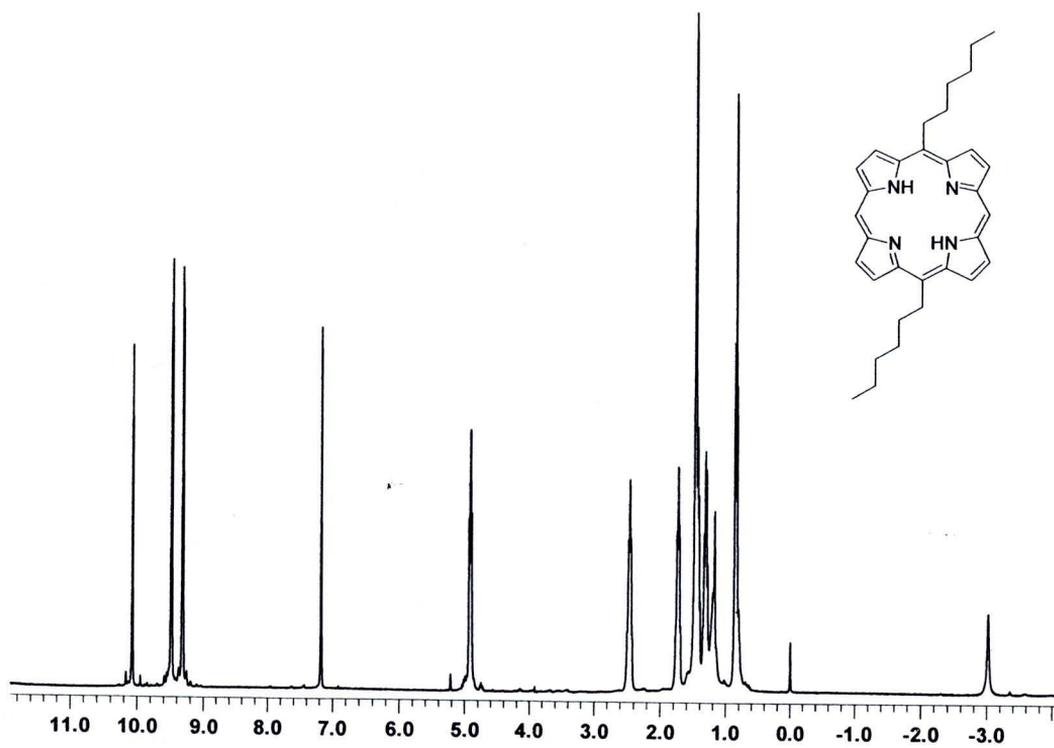


Figure A-31 The ^1H NMR spectrum of DHP (13)

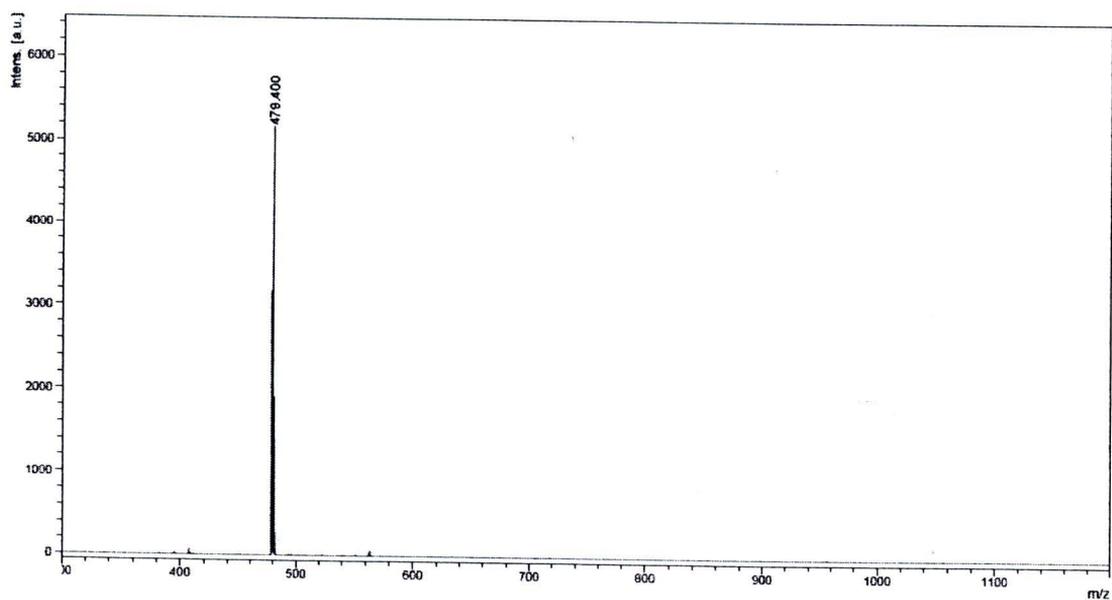


Figure A-32 The MALDI-TOF mass spectrum of DHP (13)

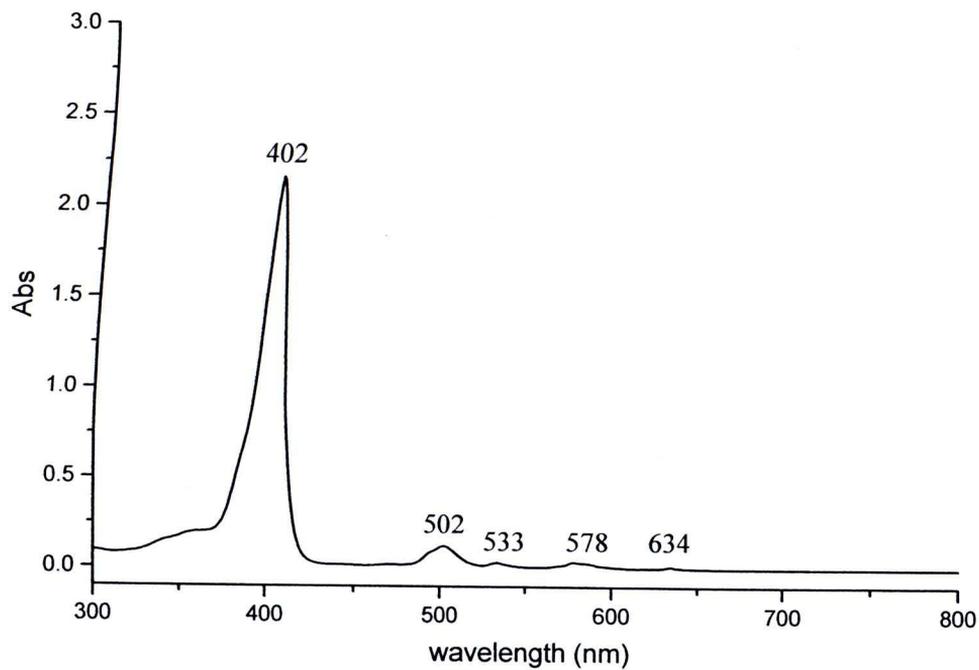


Figure A-33 The UV-visible spectrum of DHP (13)

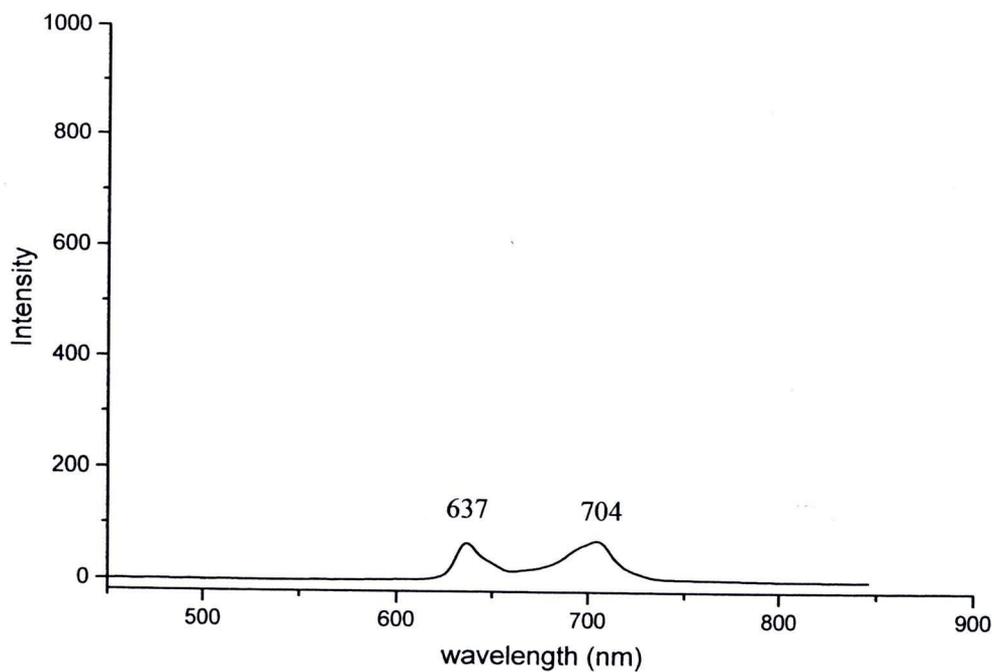


Figure A-34 The fluorescence spectrum of DHP (13)

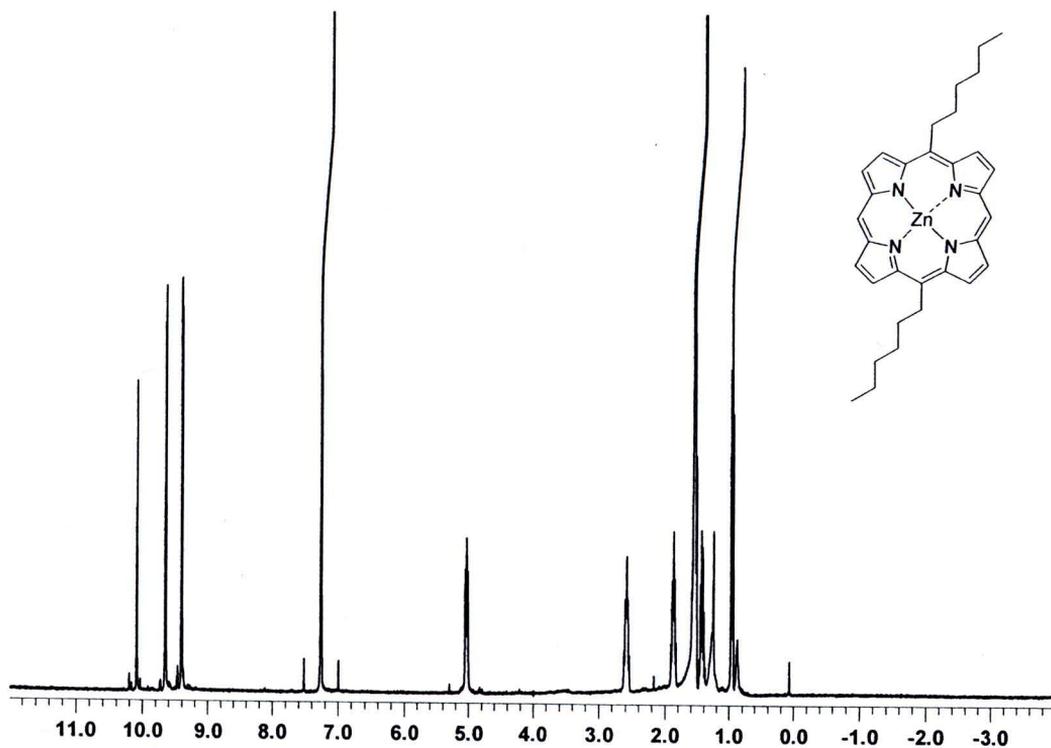


Figure A-35 The ^1H NMR spectrum of Zn-DHP (14)

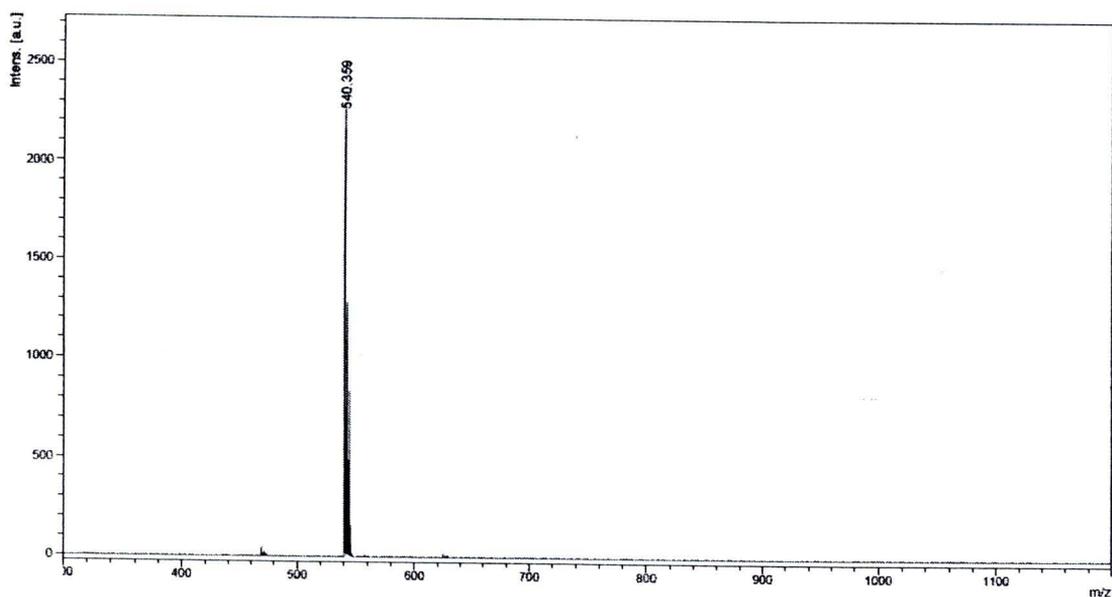


Figure A-36 The MALDI-TOF mass spectrum of Zn-DHP (14)

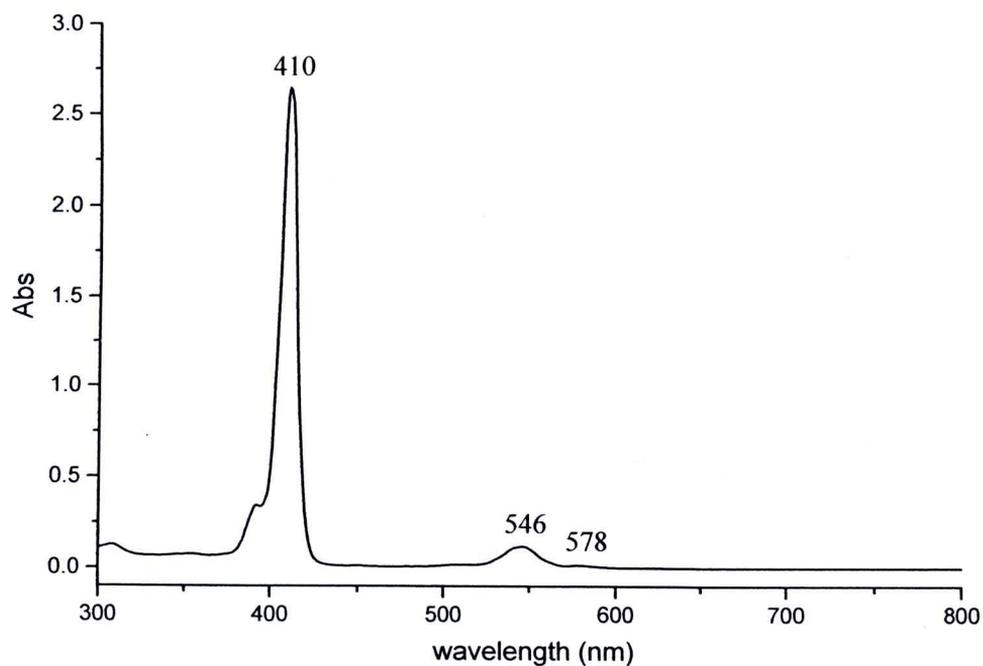


Figure A-37 The UV-visible spectrum of Zn-DHP (14)

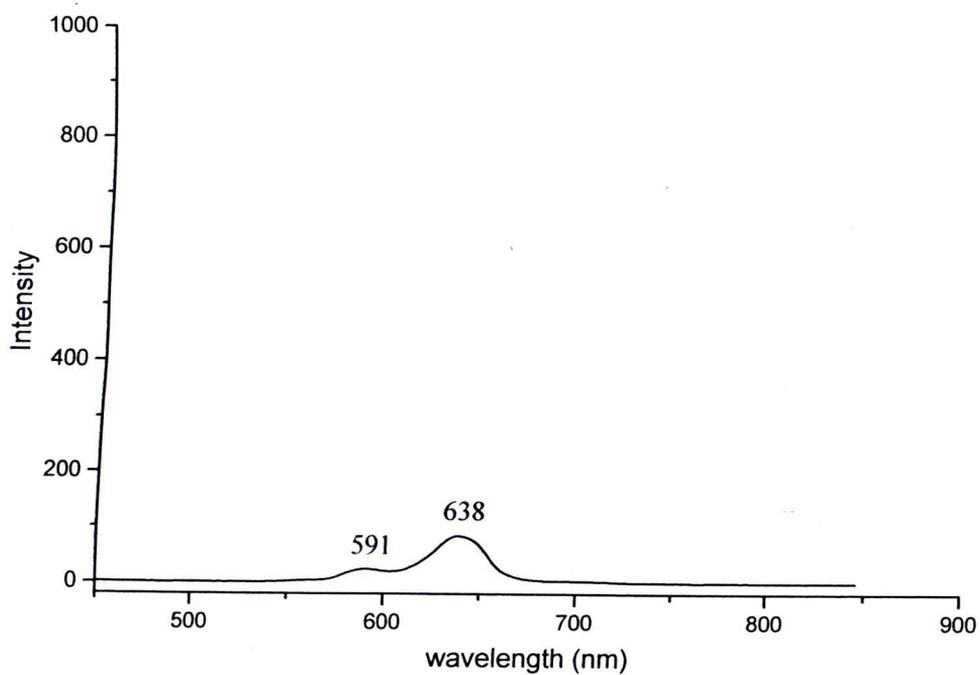


Figure A-38 The fluorescence spectrum of Zn-DHP (14)

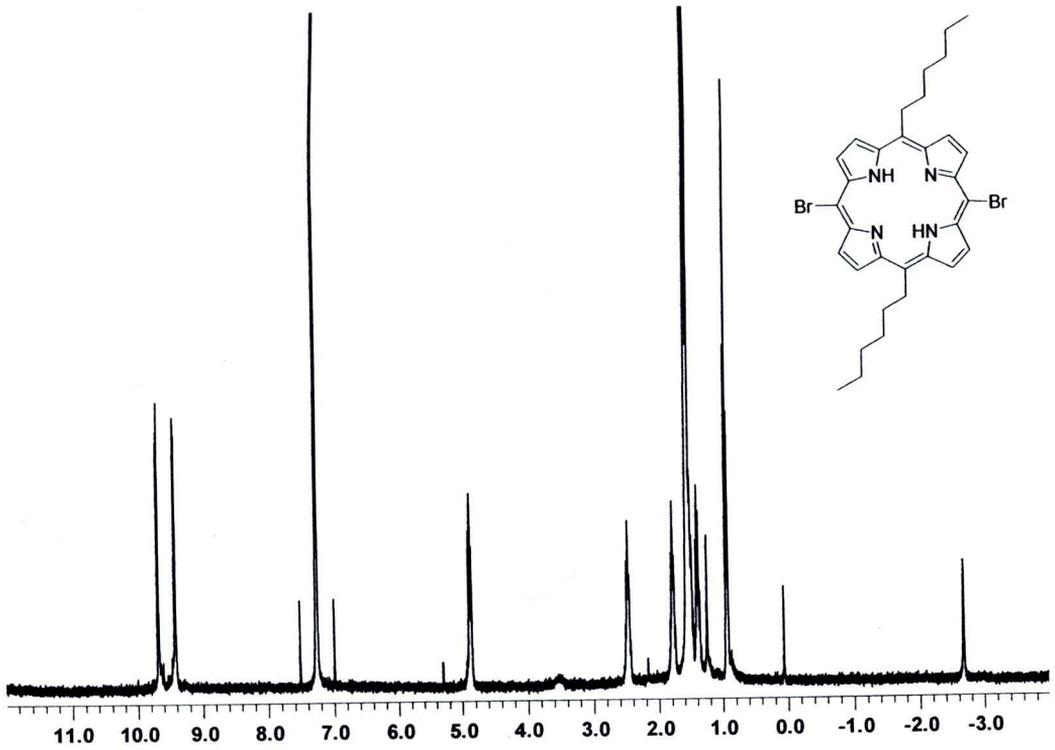


Figure A-39 The ^1H NMR spectrum of Br₂DHP (15)

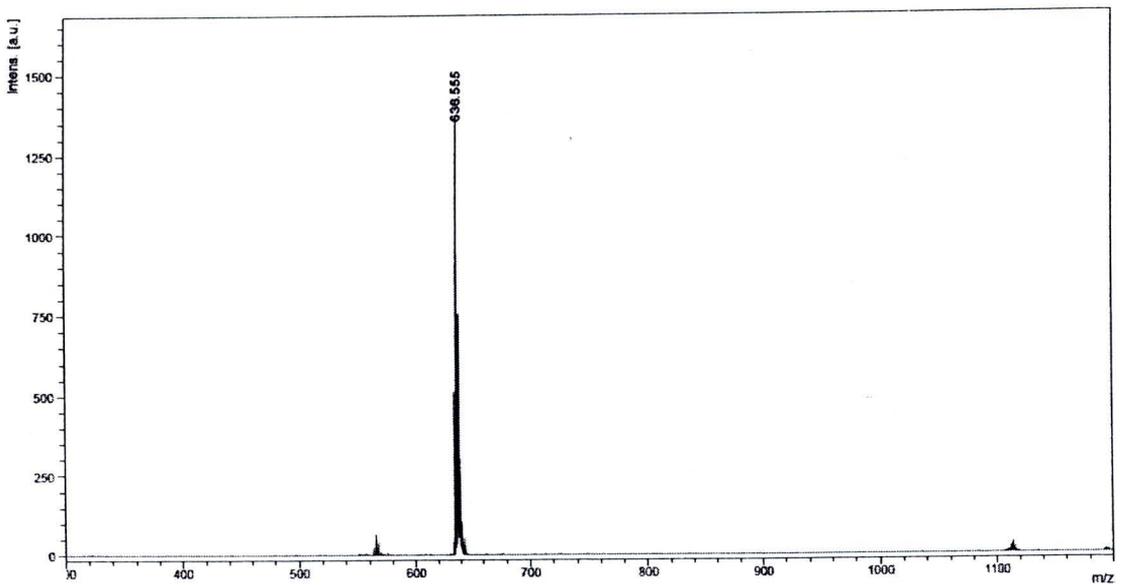


Figure A-40 The MALDI-TOF mass spectrum of Br₂DHP (15)

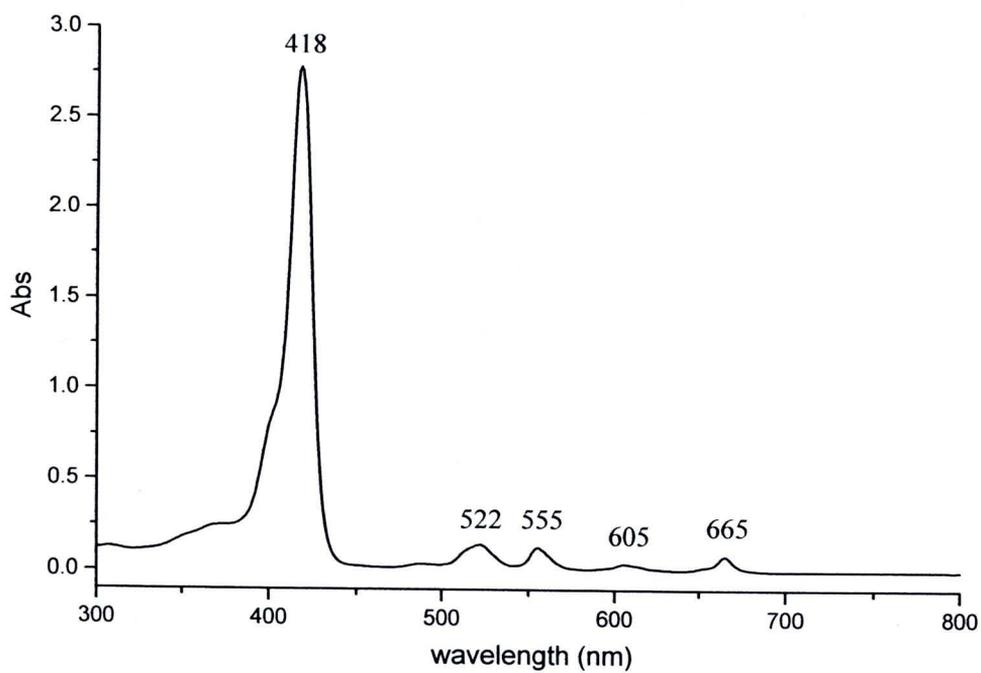


Figure A-41 The UV-visible spectrum of Br₂DHP (15)

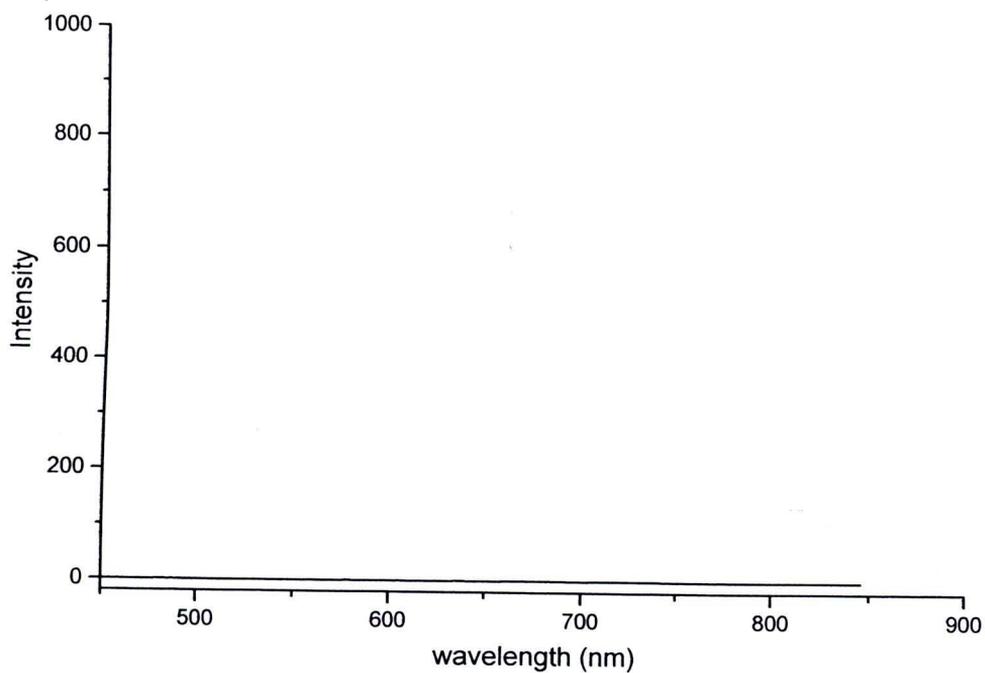


Figure A-42 The fluorescence spectrum of Br₂DHP (15)

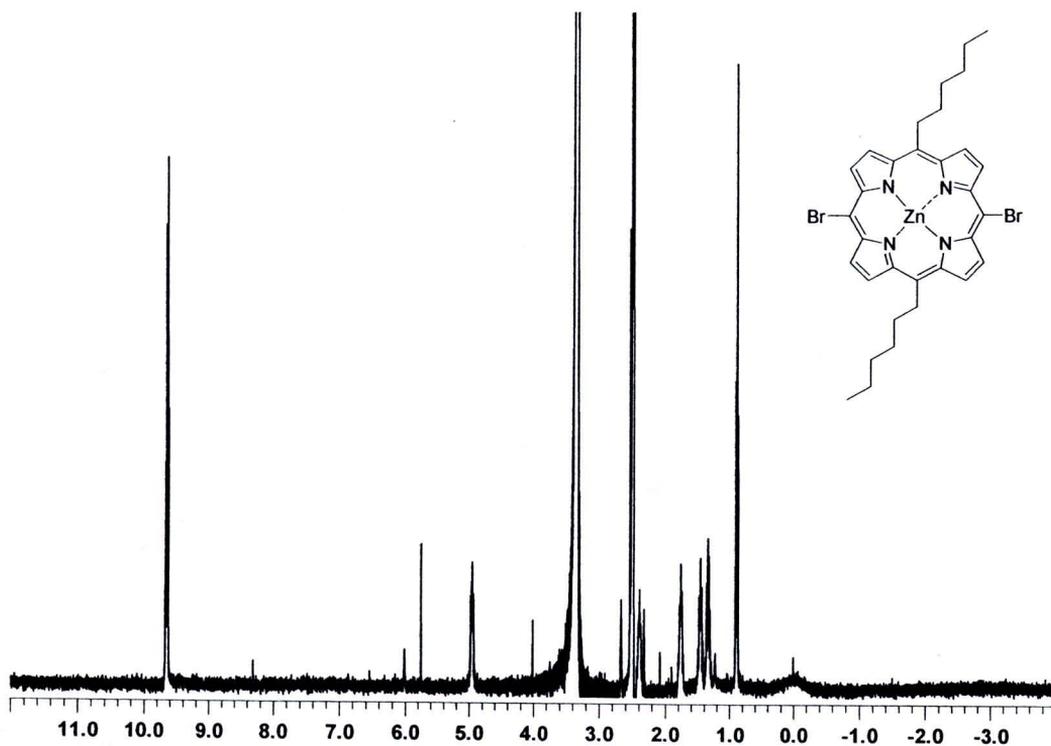


Figure A-43 The ^1H NMR spectrum of Zn-Br₂DHP (16)

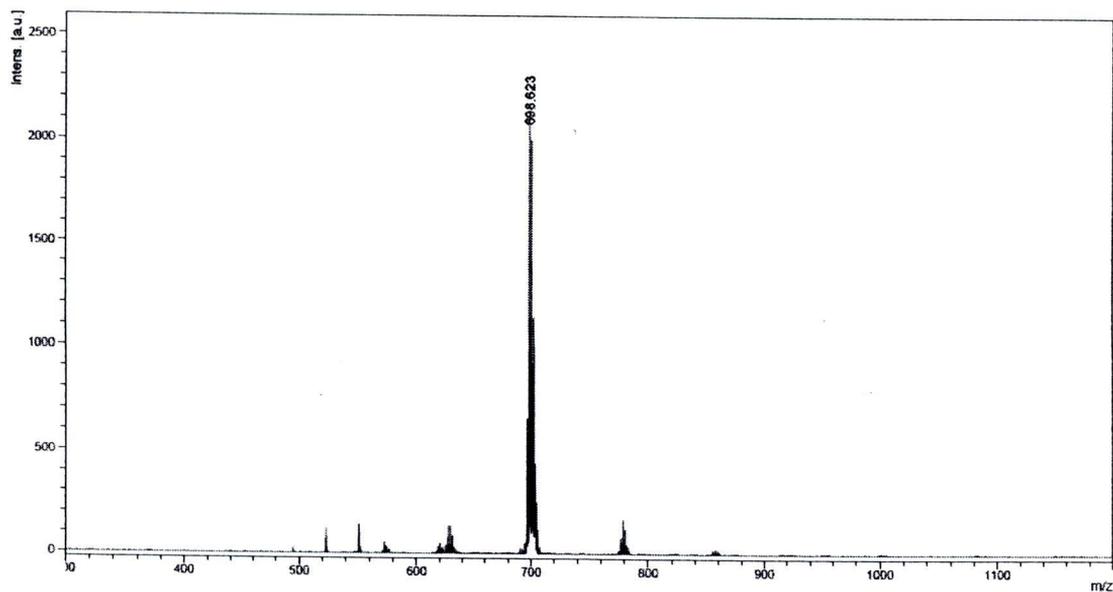


Figure A-44 The MALDI-TOF mass spectrum of Zn-Br₂DHP (16)

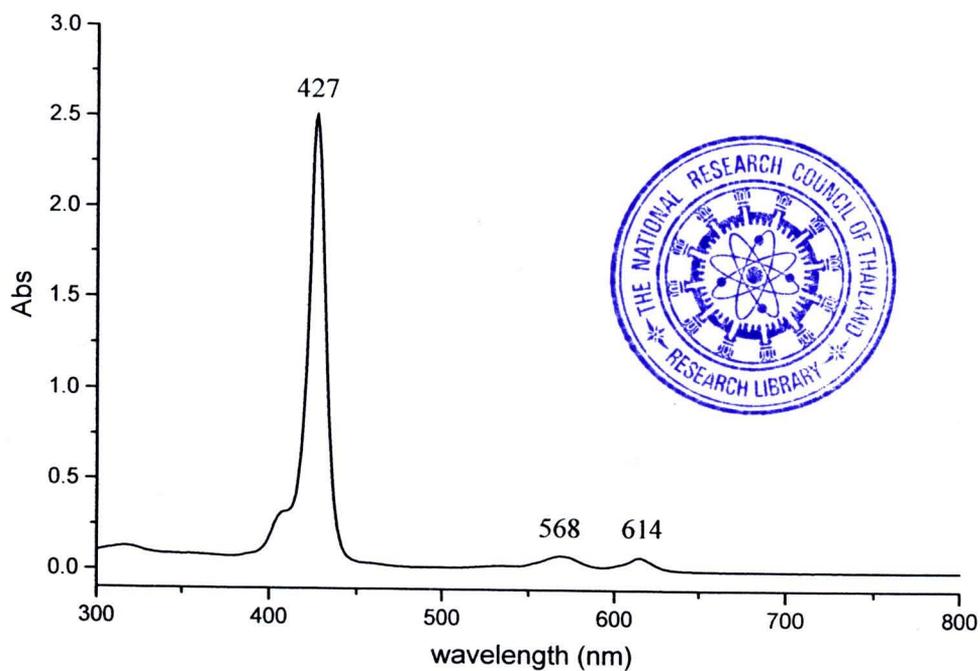


Figure A-45 The UV-visible spectrum of Zn-Br₂DHP (16)

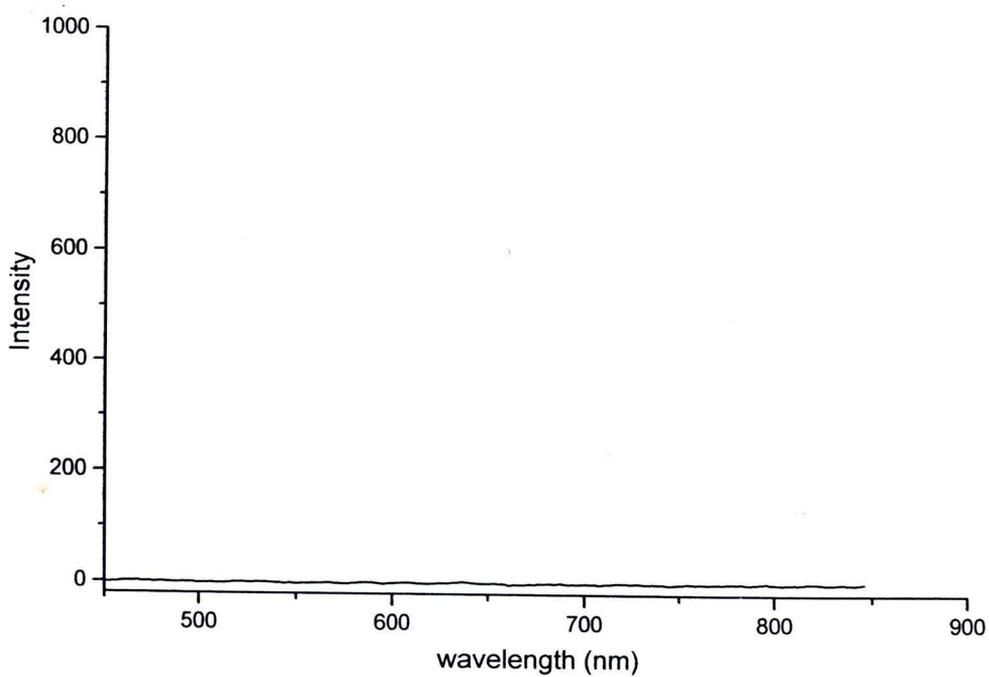


Figure A-46 The fluorescence spectrum of Zn-Br₂DHP (16)

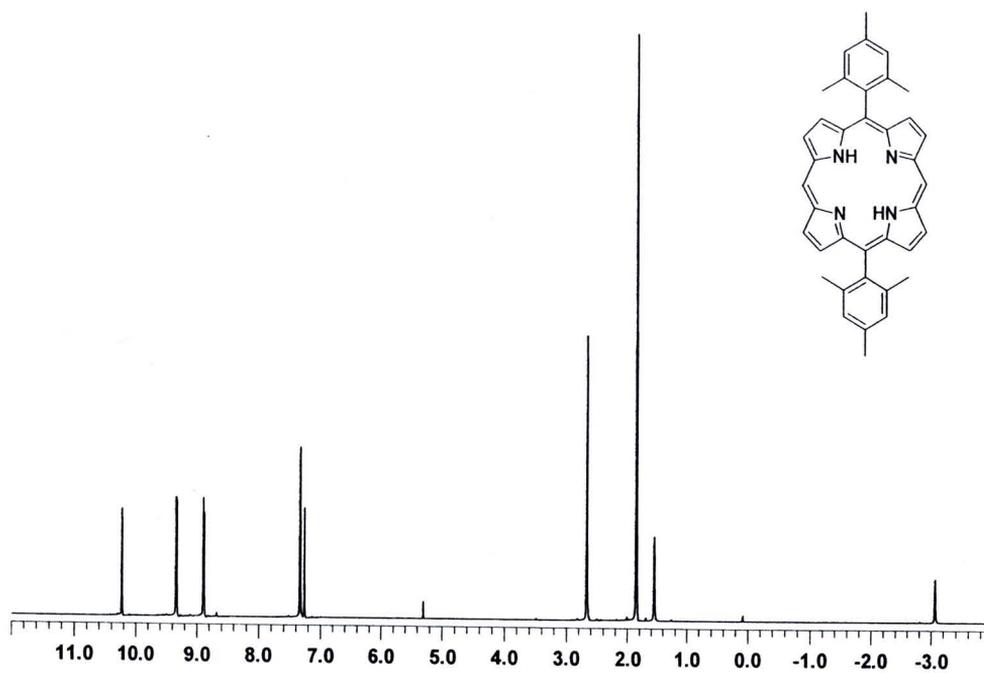


Figure A-47 The ^1H NMR spectrum of DMP (17)

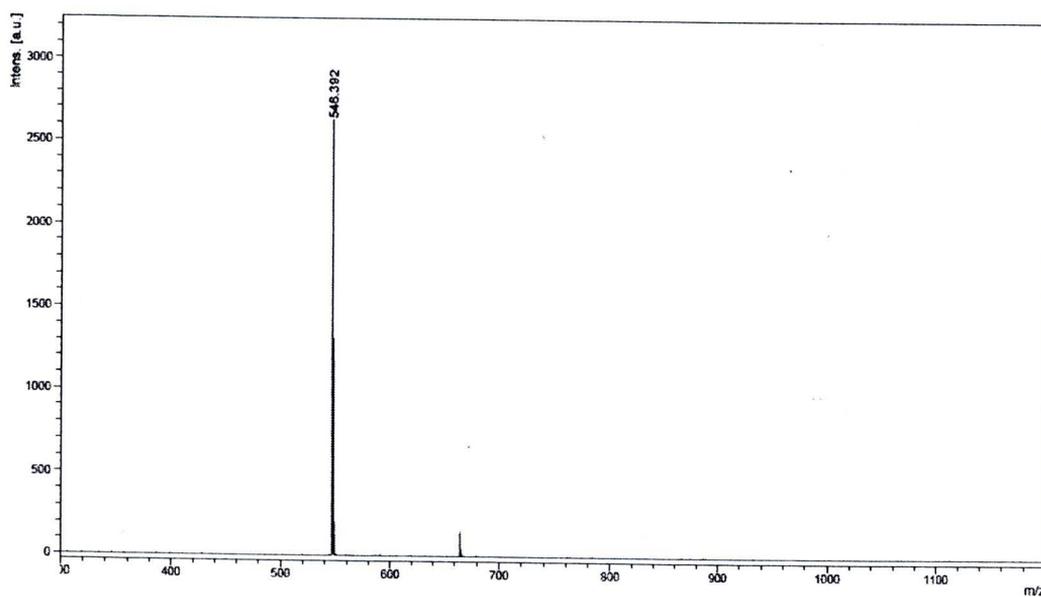


Figure A-48 The MALDI-TOF mass spectrum of DMP (17)

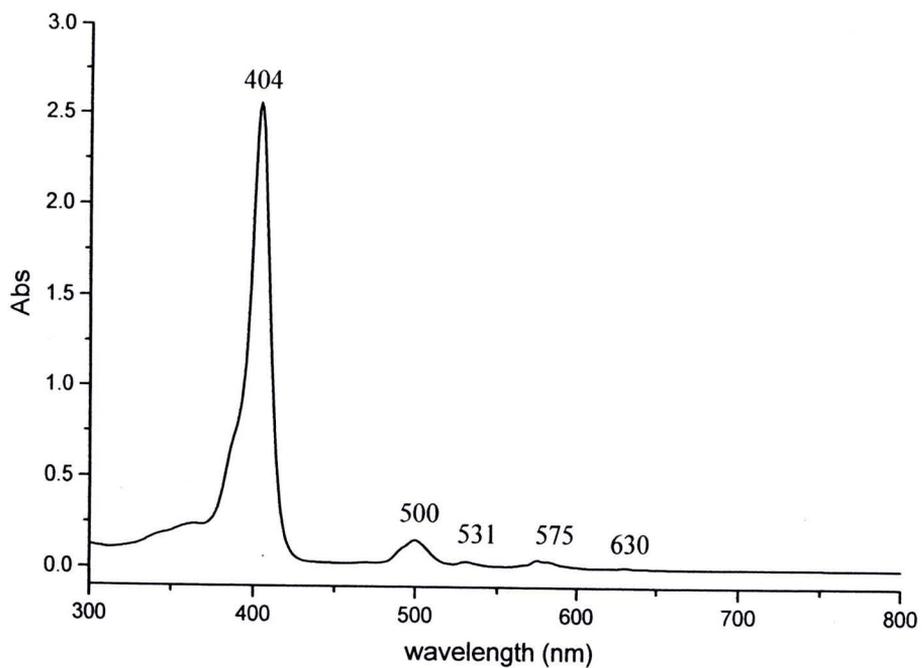


Figure A-49 The UV-visible spectrum of DMP (17)

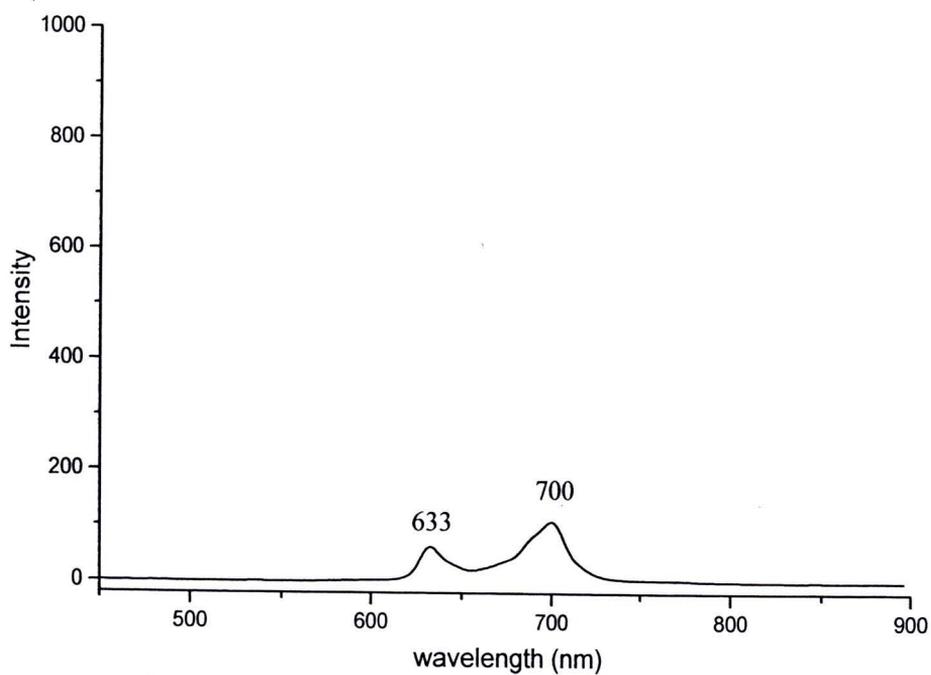


Figure A-50 The fluorescence spectrum of DMP (17)

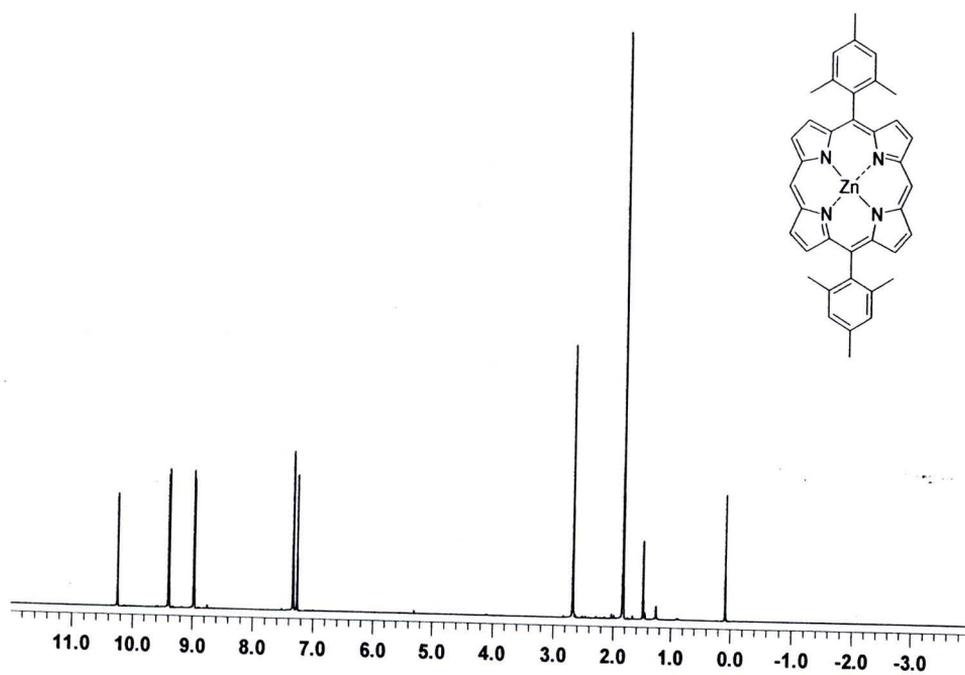


Figure A-51 The ^1H NMR spectrum of Zn-DMP (18)

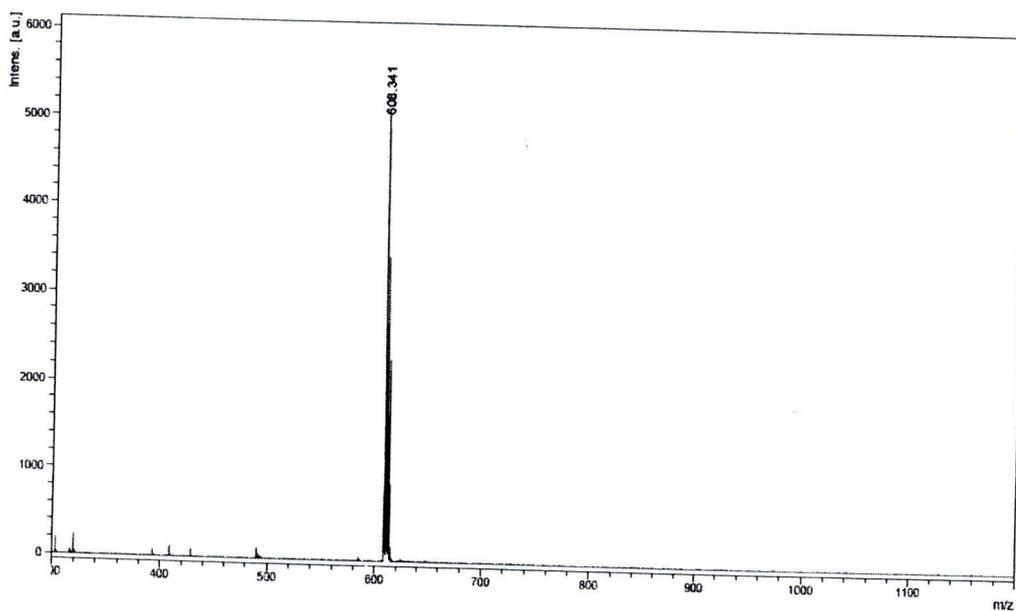


Figure A-52 The MALDI-TOF mass spectrum of Zn-DMP (18)

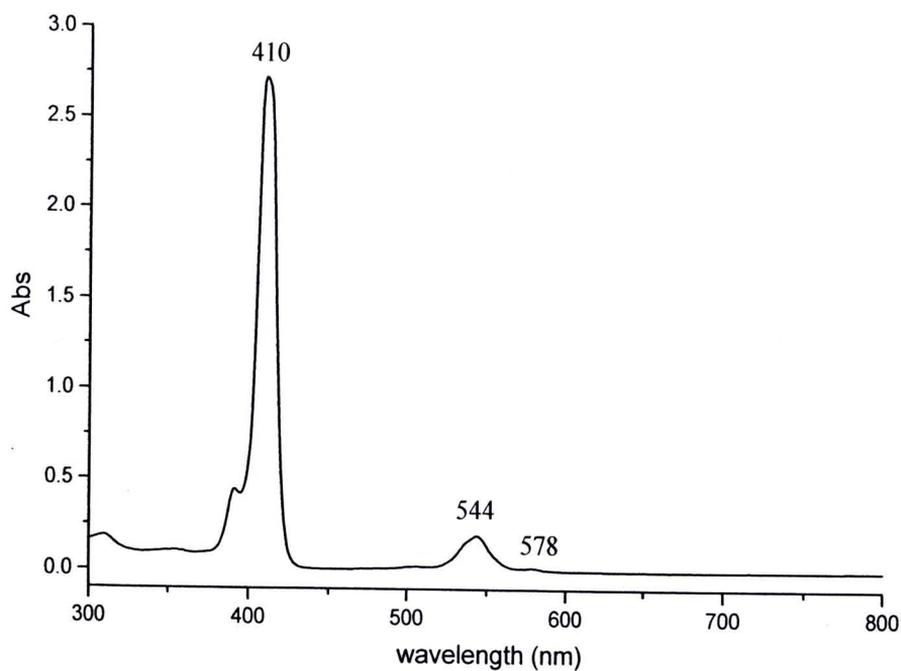


Figure A-53 The UV-visible spectrum of Zn-DMP (18)

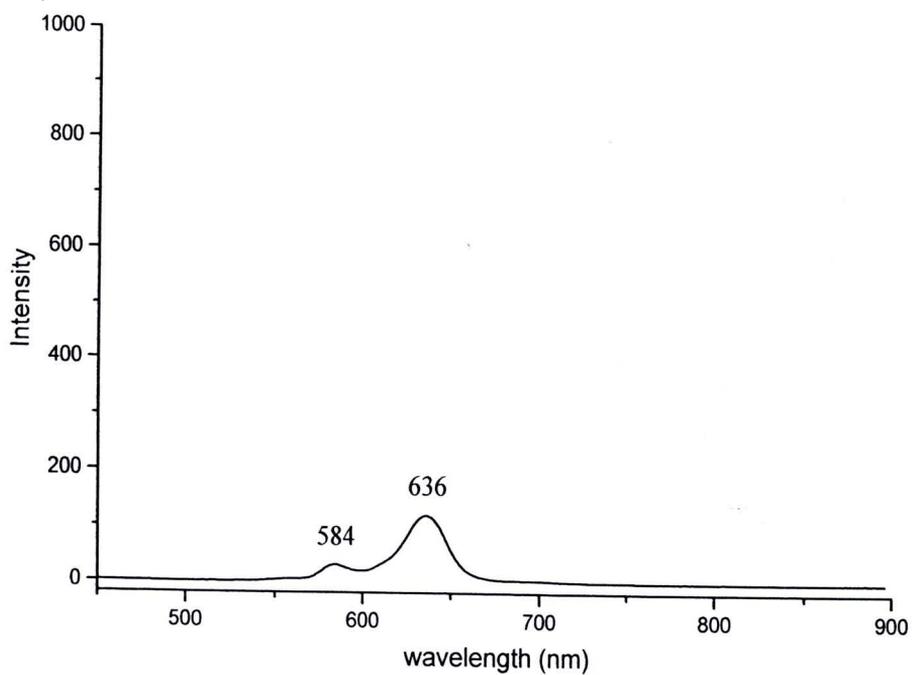


Figure A-54 The fluorescence spectrum of Zn-DMP (18)

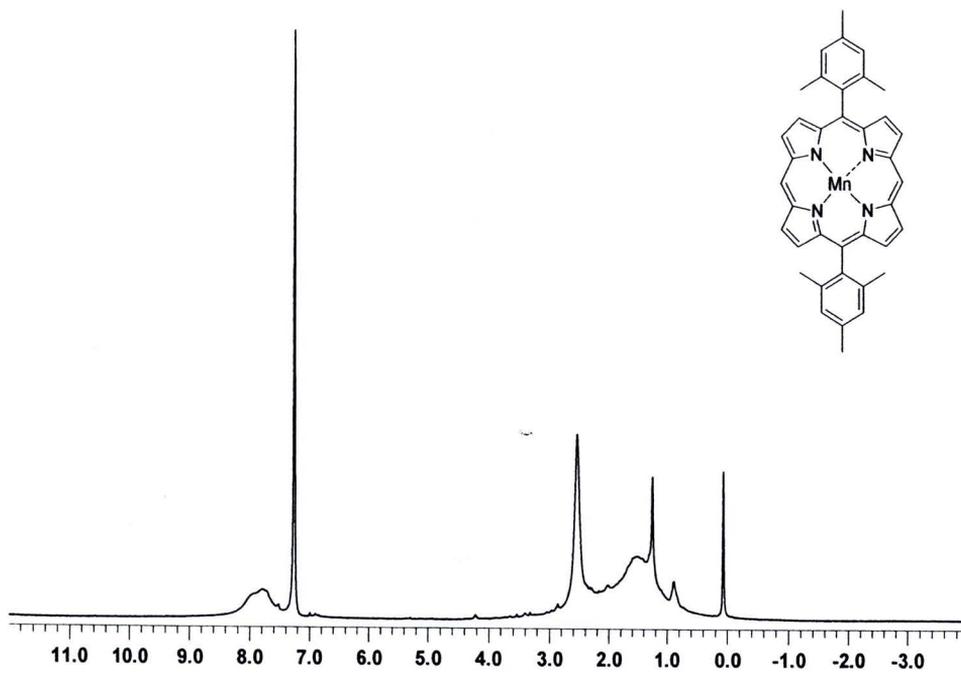


Figure A-55 The ^1H NMR spectrum of Mn-DMP (19)

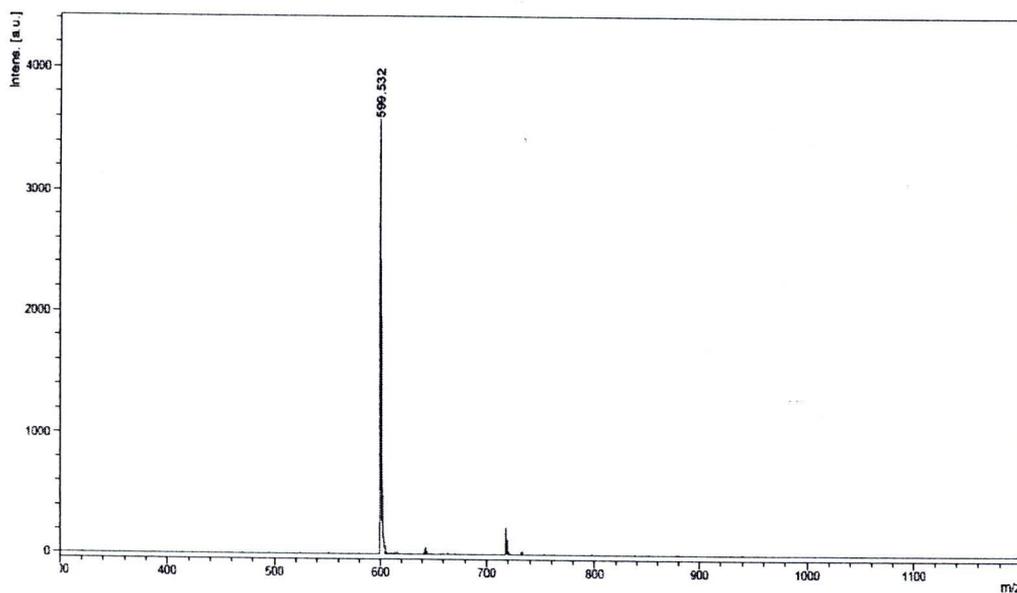


Figure A-56 The MALDI-TOF mass spectrum of Mn-DMP (19)

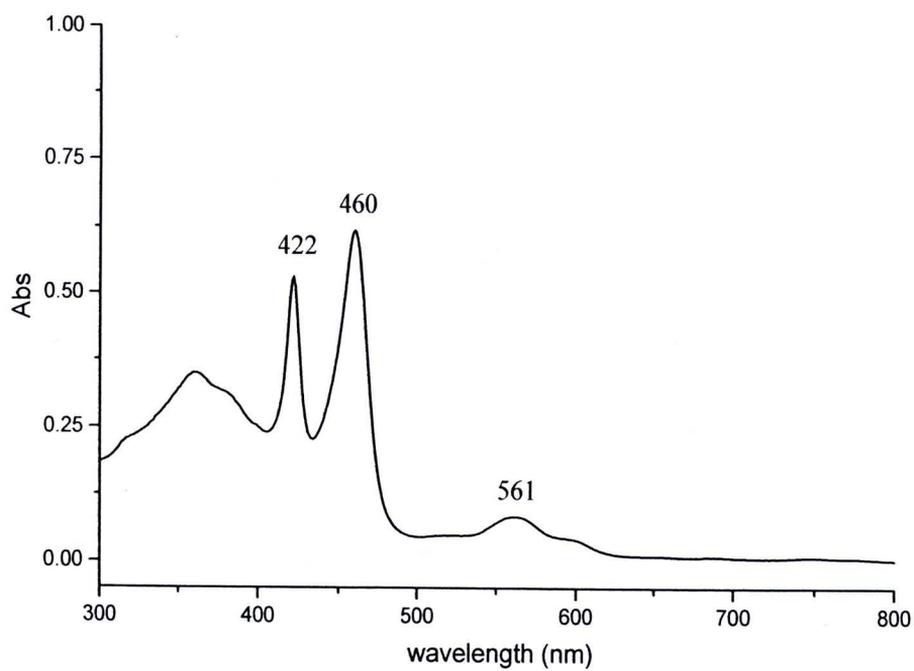


Figure A-57 The UV-visible spectrum of Mn-DMP (19)

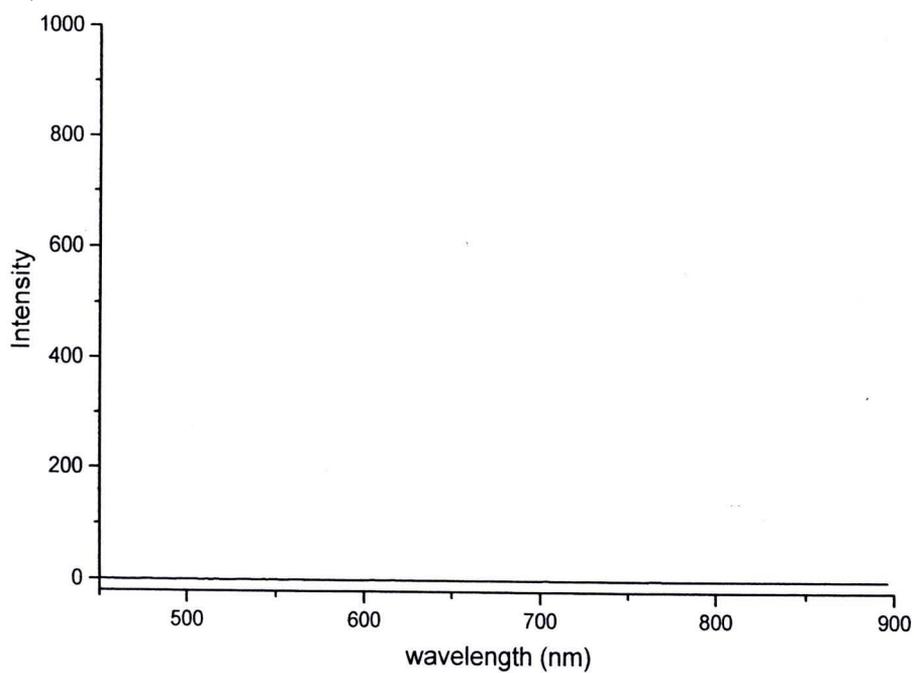


Figure A-58 The fluorescence spectrum of Mn-DMP (19)

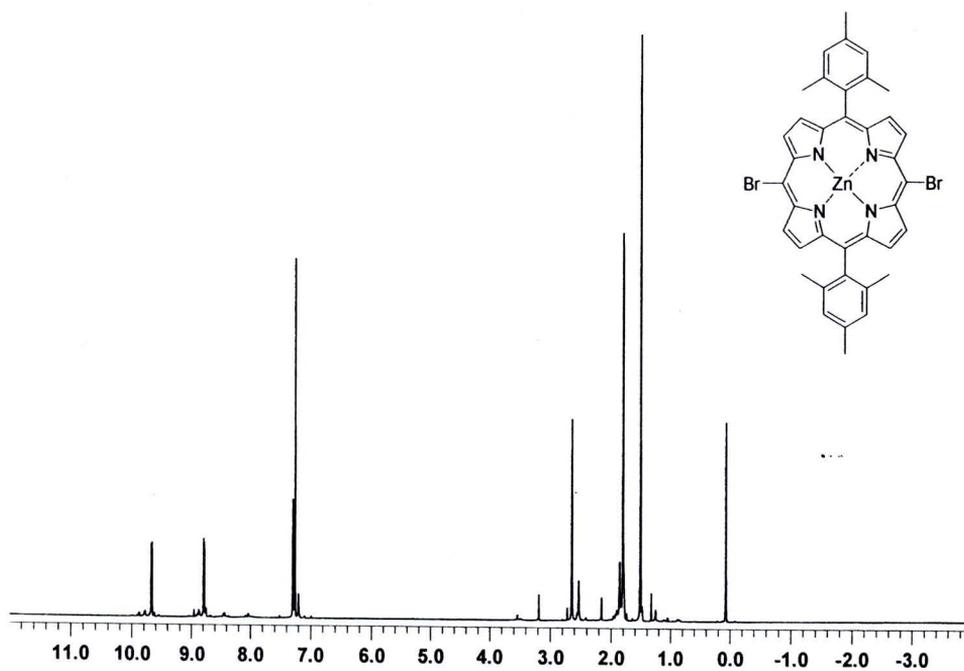


Figure A-59 The ^1H NMR spectrum of Zn-Br₂DMP (20)

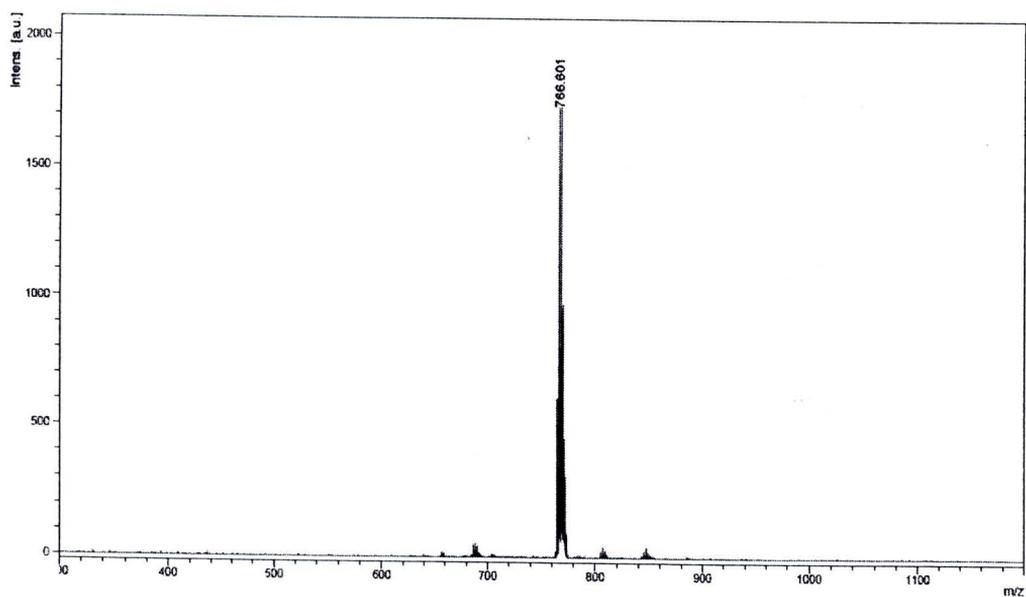


Figure A-60 The MALDI-TOF mass spectrum of Zn-Br₂DMP (20)

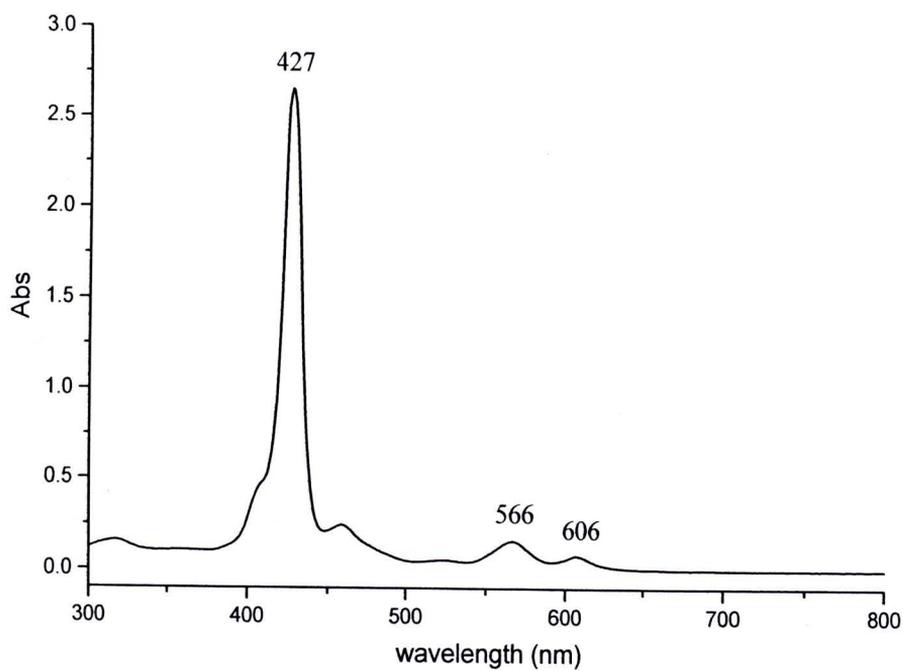


Figure A-61 The UV-visible spectrum of Zn-Br₂DMP (20)

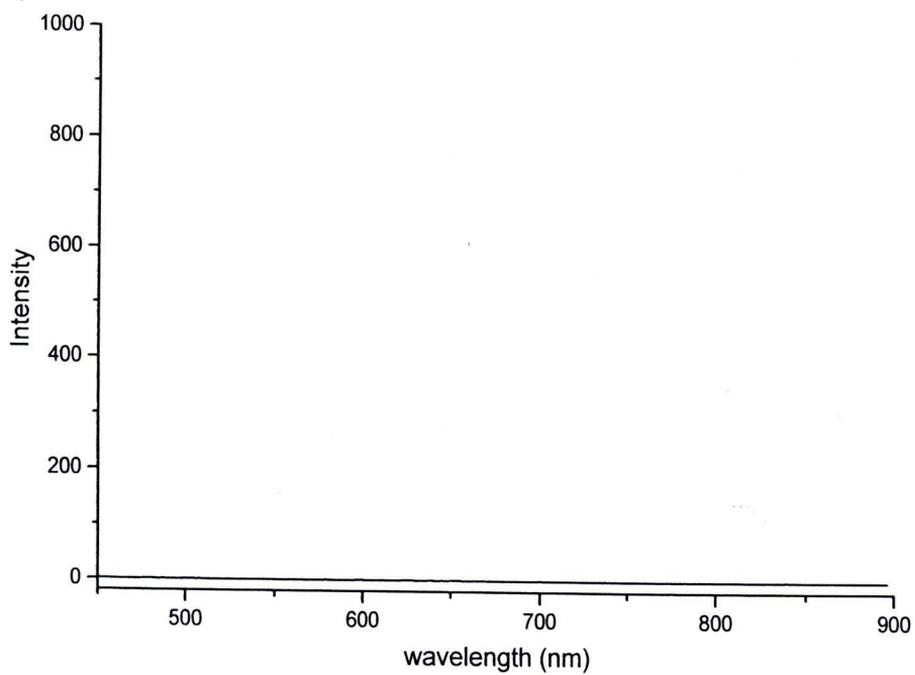


Figure A-62 The fluorescence spectrum of Zn-Br₂DMP (20)

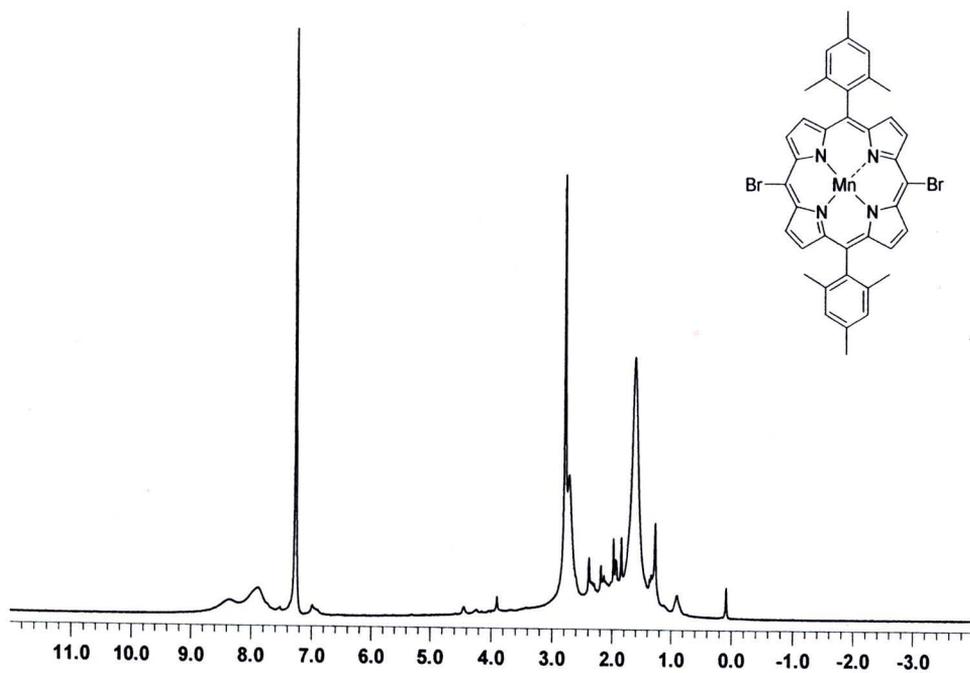


Figure A-63 The ^1H NMR spectrum of Mn-Br₂DMP (21)

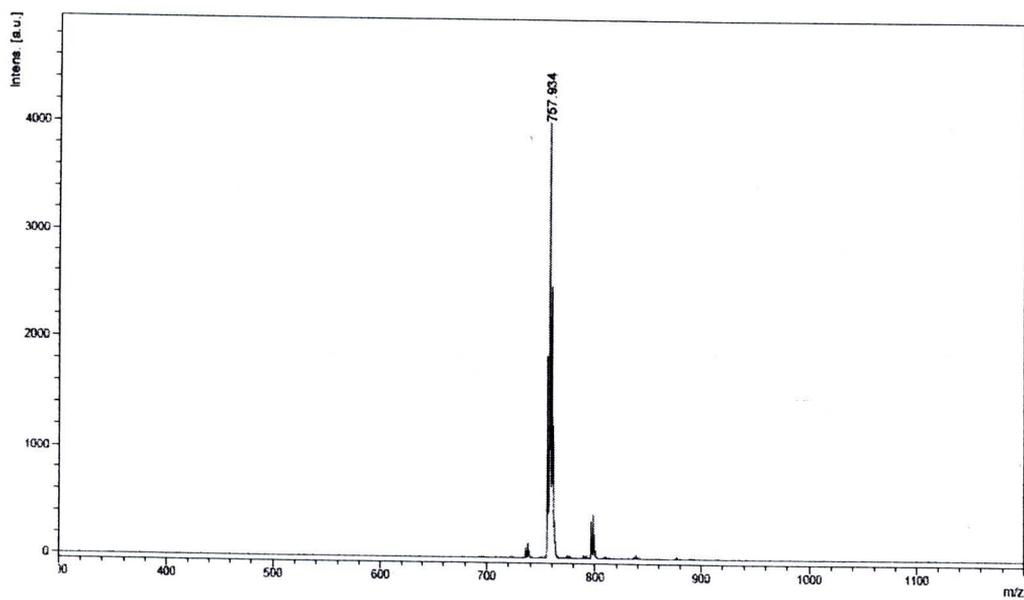


Figure A-64 The MALDI-TOF mass spectrum of Mn-Br₂DMP (21)

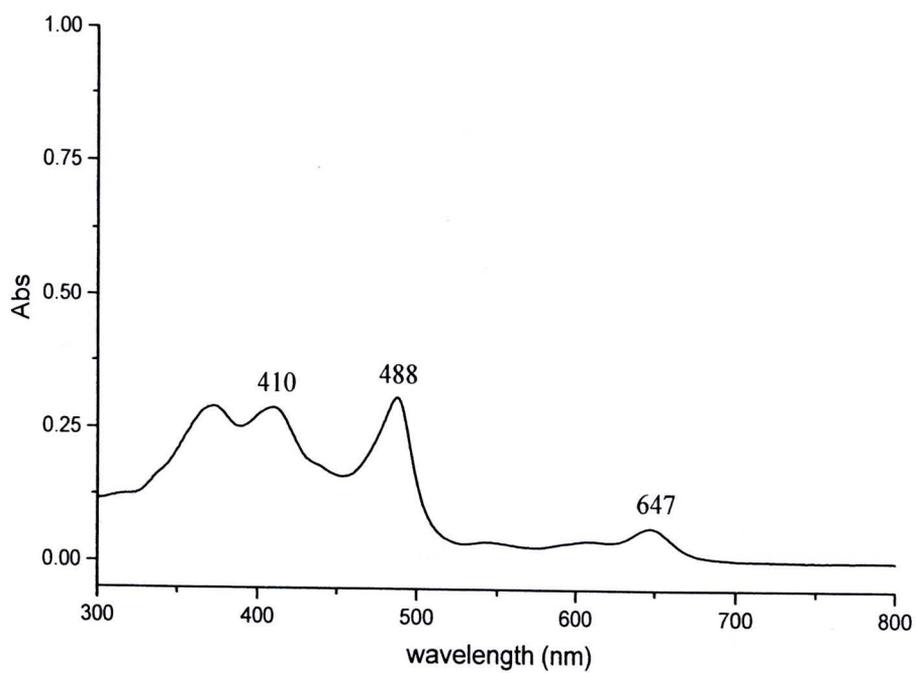


Figure A-65 The UV-visible spectrum of Mn-Br₂DMP (21)

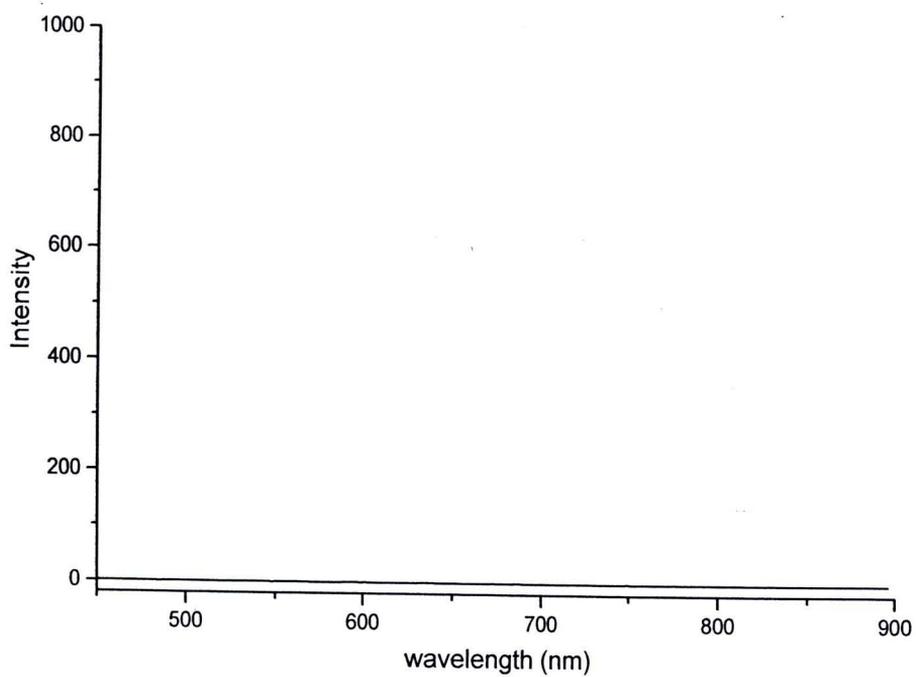


Figure A-66 The fluorescence spectrum of Mn-Br₂DMP (21)

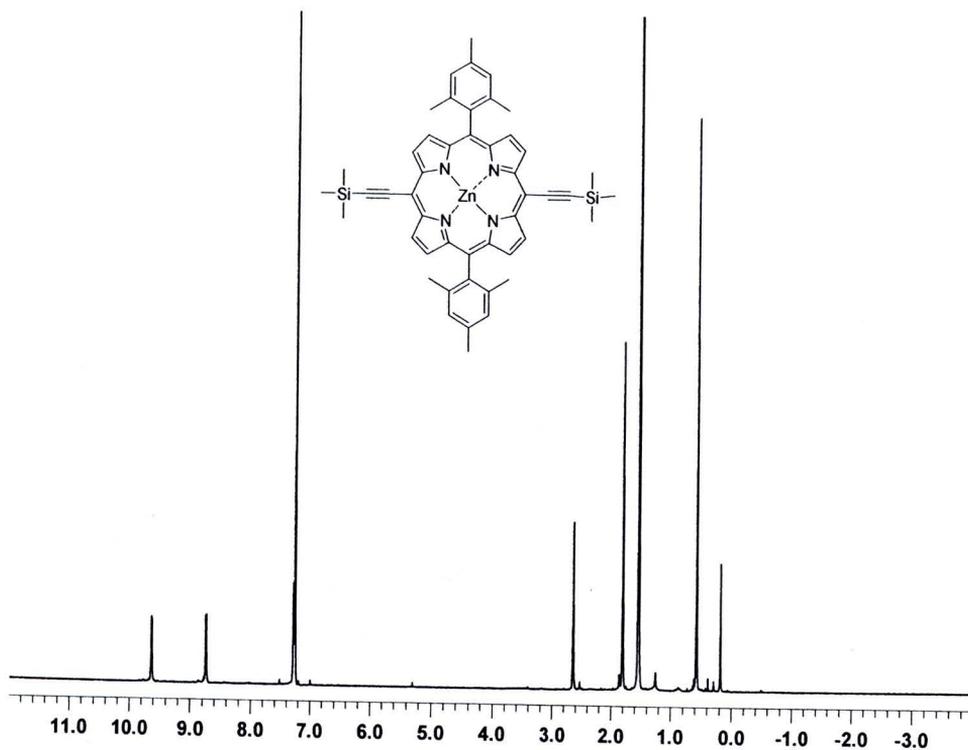


Figure A-67 The ¹H NMR spectrum of Zn-(TMSE)₂DMP (22)

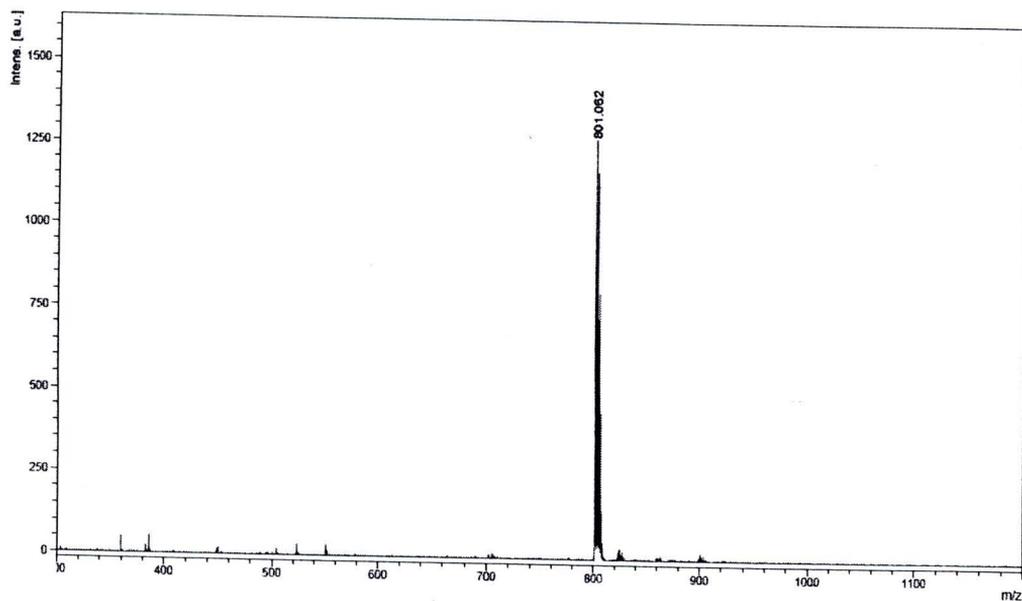


Figure A-68 The MALDI-TOF mass spectrum of Zn-(TMSE)₂DMP (22)

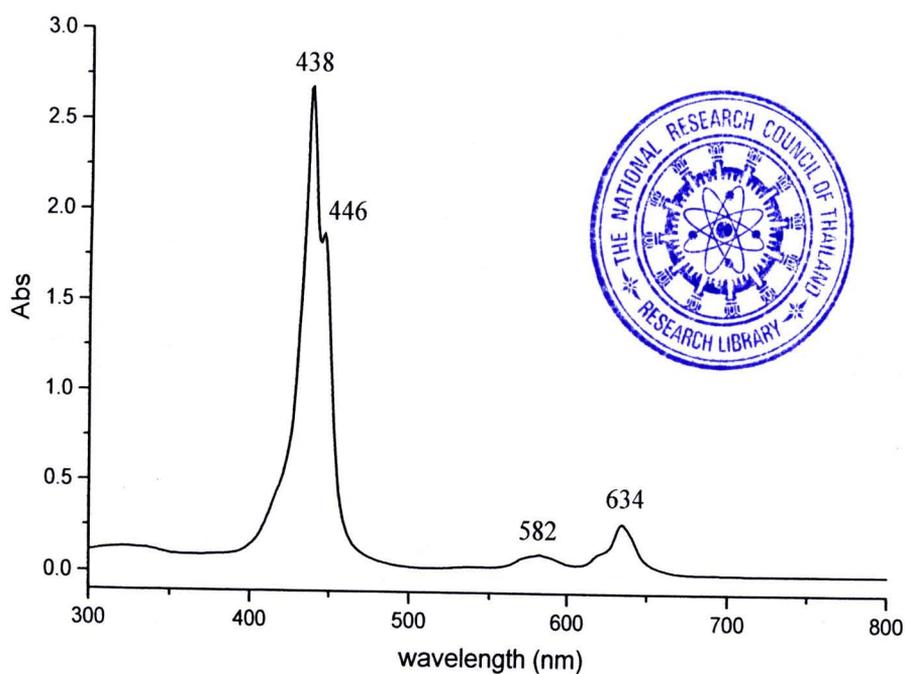


Figure A-69 The UV-visible spectrum of Zn-(TMSE)₂DMP (22)

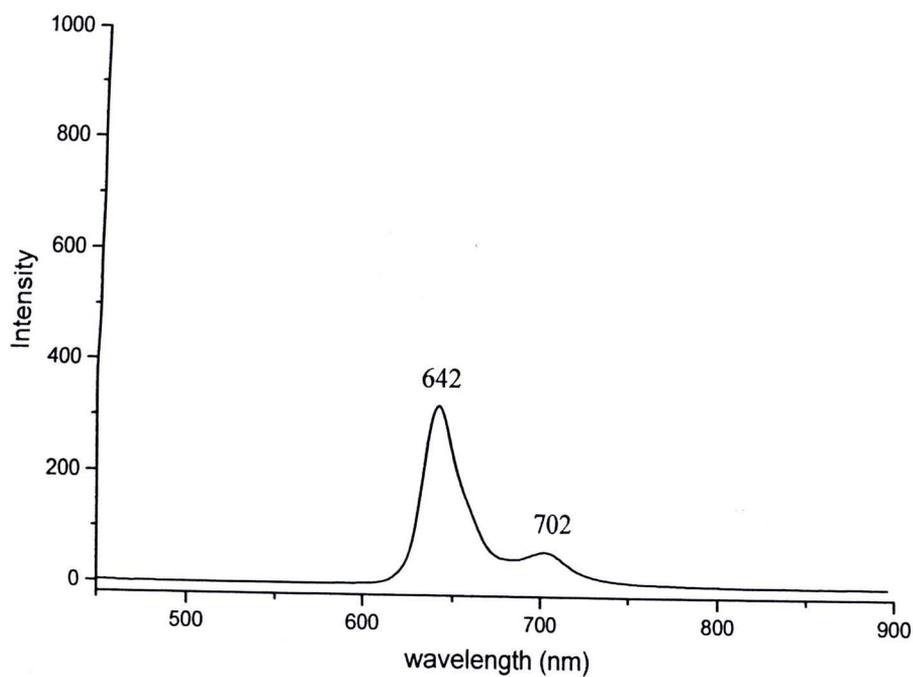


Figure A-70 The fluorescence spectrum of Zn-(TMSE)₂DMP (22)

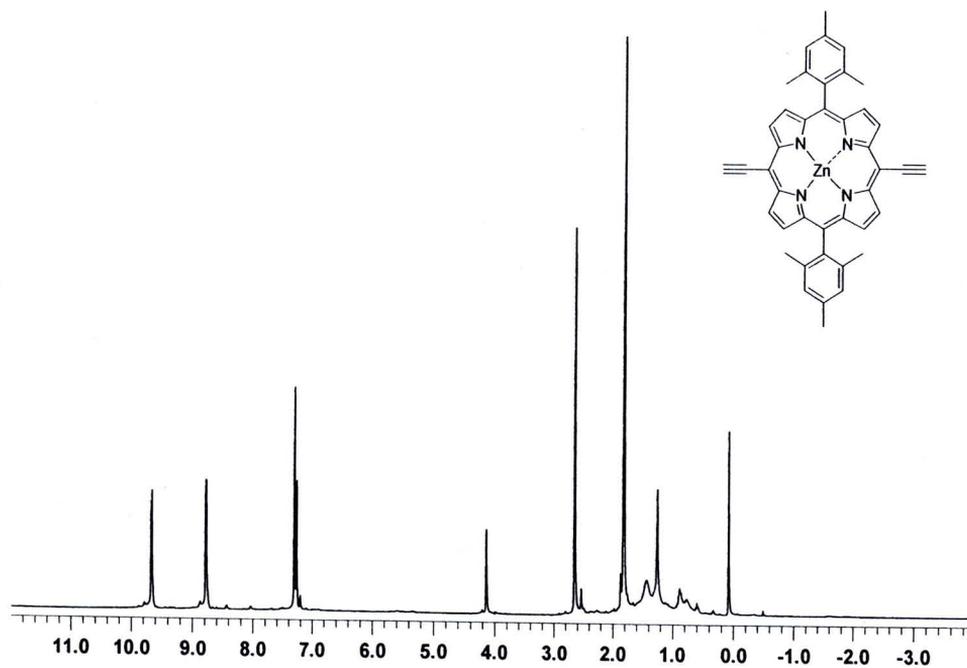


Figure A-71 The ^1H NMR spectrum of Zn-E₂DMP (23)

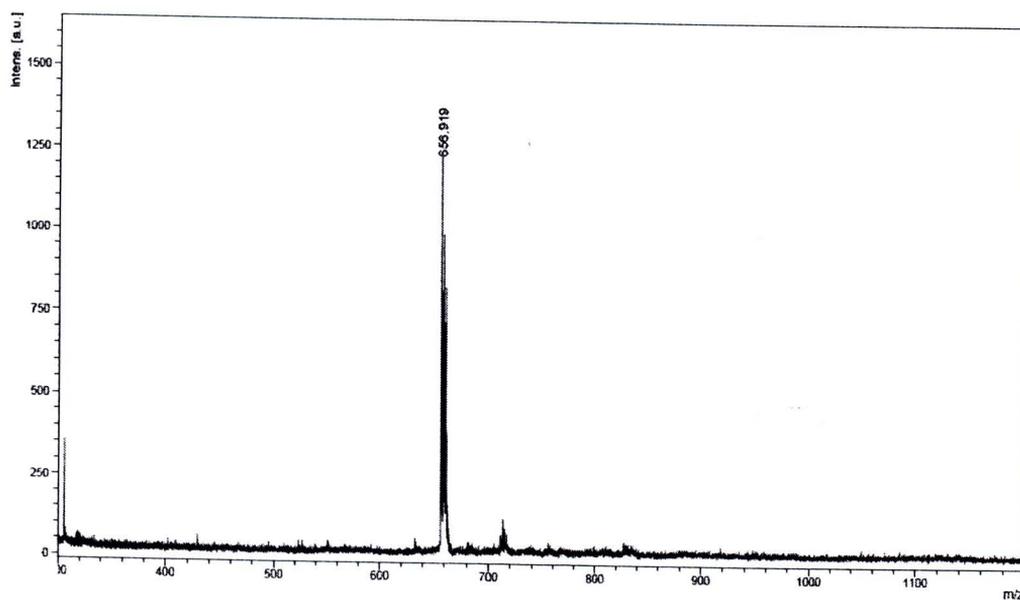


Figure A-72 The MALDI-TOF mass spectrum of Zn-E₂DMP (23)

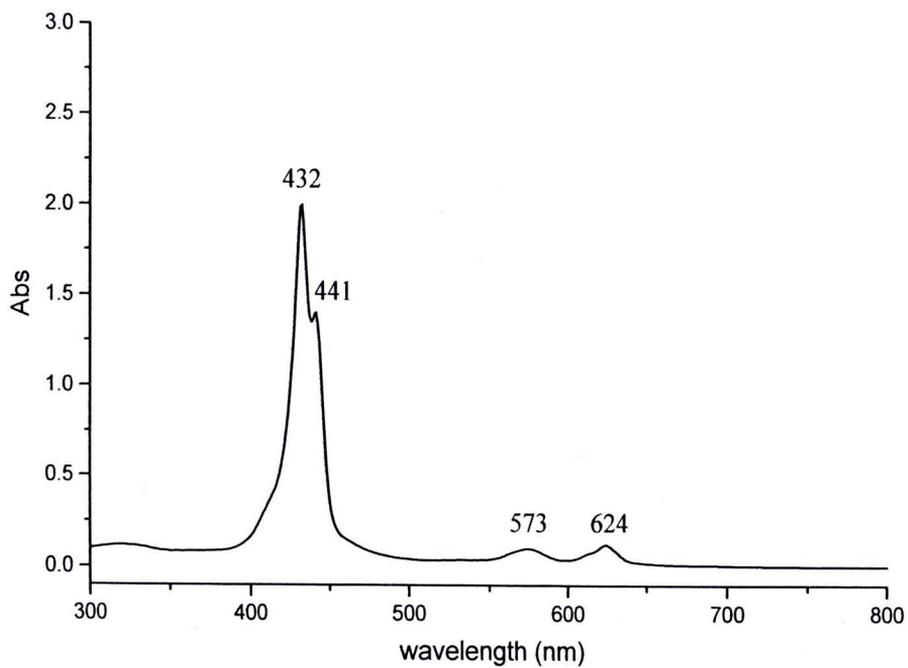


Figure A-73 The UV-visible spectrum of Zn-E₂DMP (23)

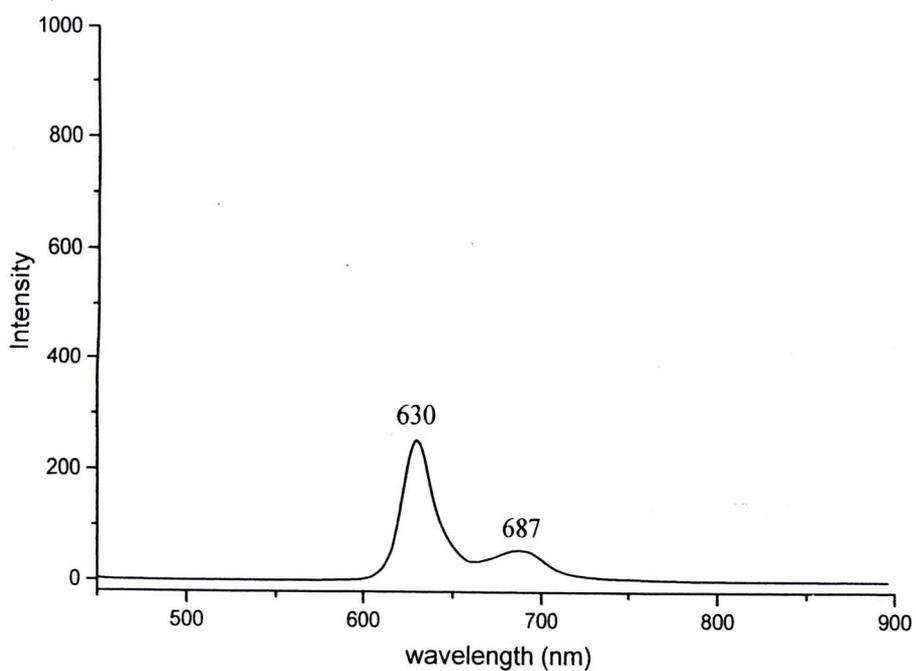


Figure A-74 The fluorescence spectrum of Zn-E₂DMP (23)

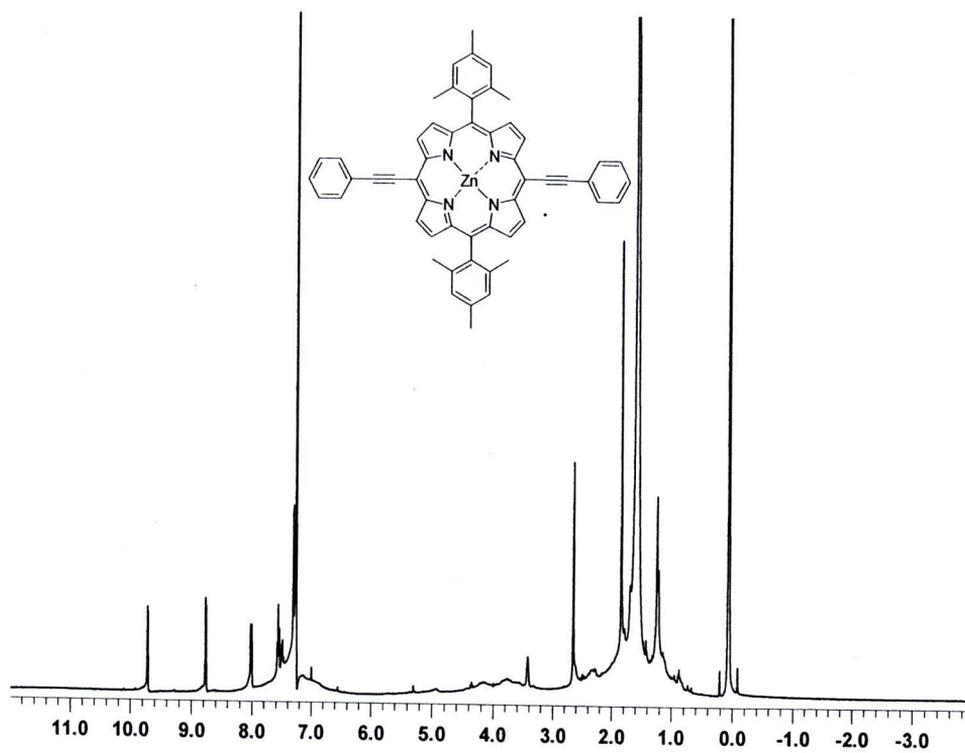


Figure A-75 The ^1H NMR spectrum of Zn-(PE)₂DMP (24)

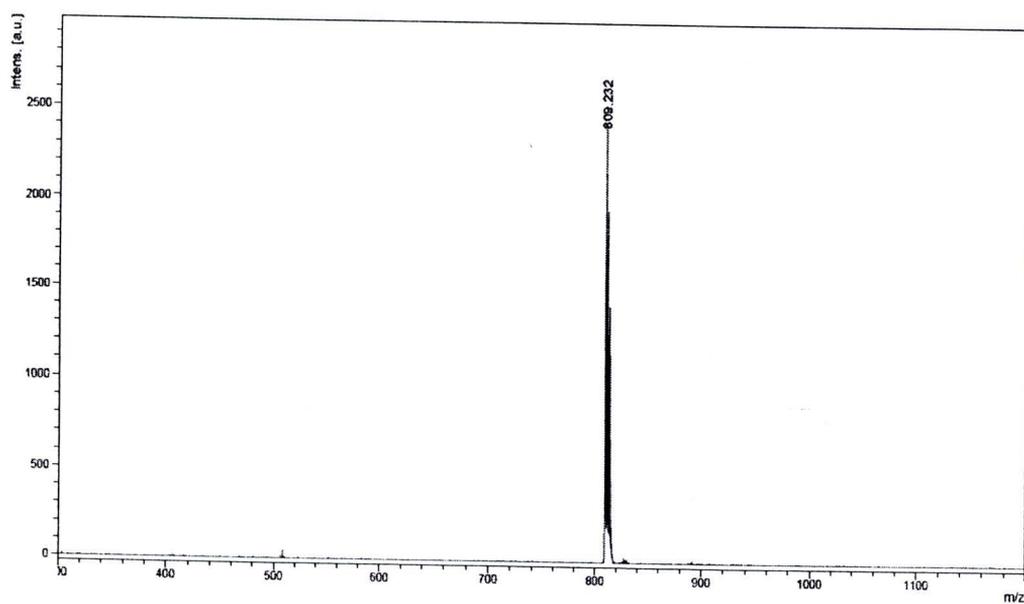


Figure A-76 The MALDI-TOF mass spectrum of Zn-(PE)₂DMP (24)

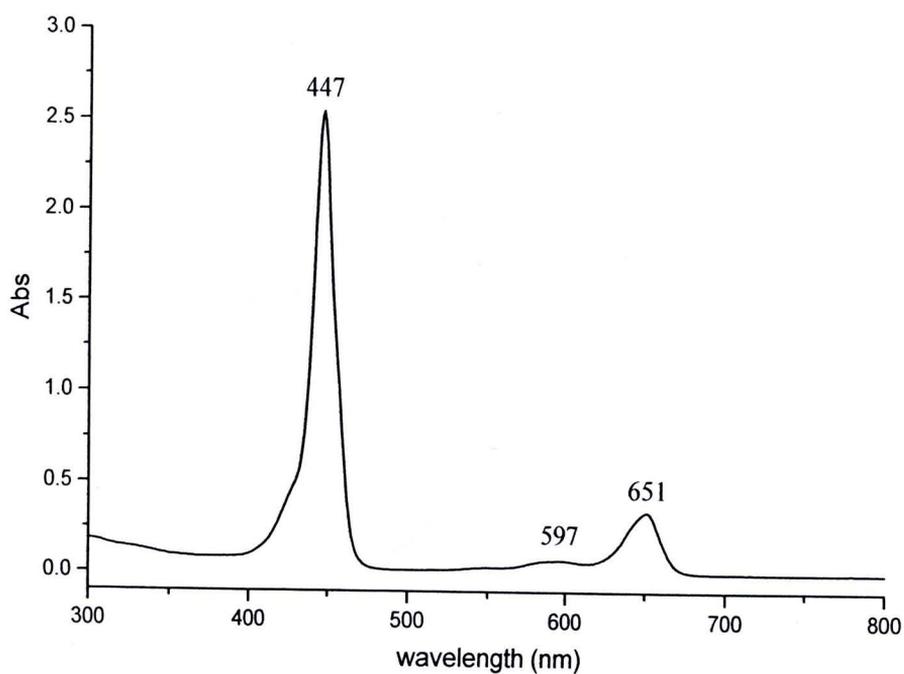


Figure A-77 The UV-visible spectrum of Zn-(PE)₂DMP (24)

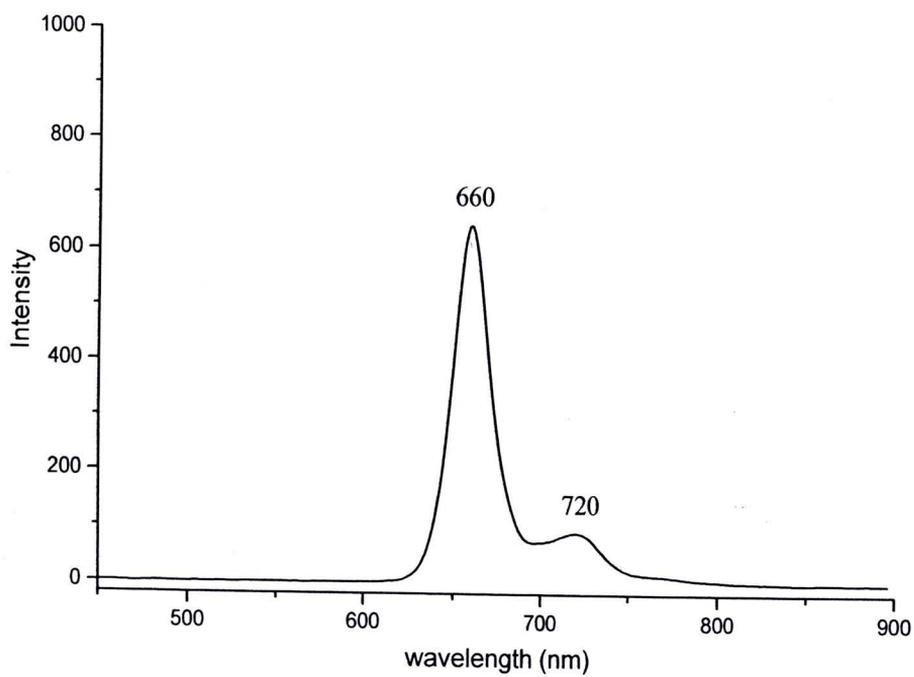


Figure A-78 The fluorescence spectrum of Zn-(PE)₂DMP (24)

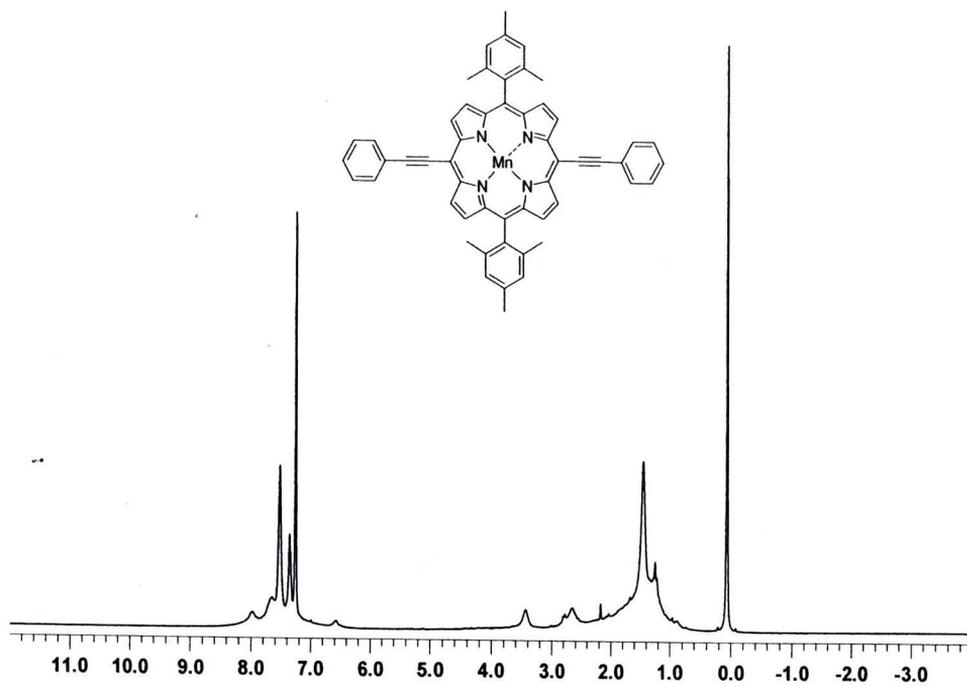


Figure A-79 The ¹H NMR spectrum of Mn-(PE)₂DMP (25)

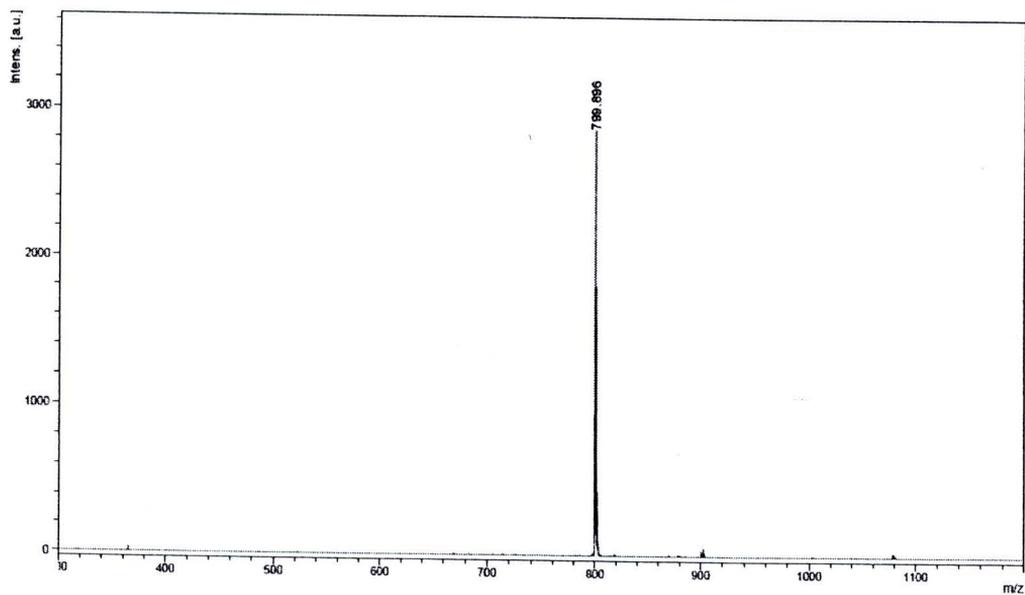


Figure A-80 The MALDI-TOF mass spectrum of Mn-(PE)₂DMP (25)

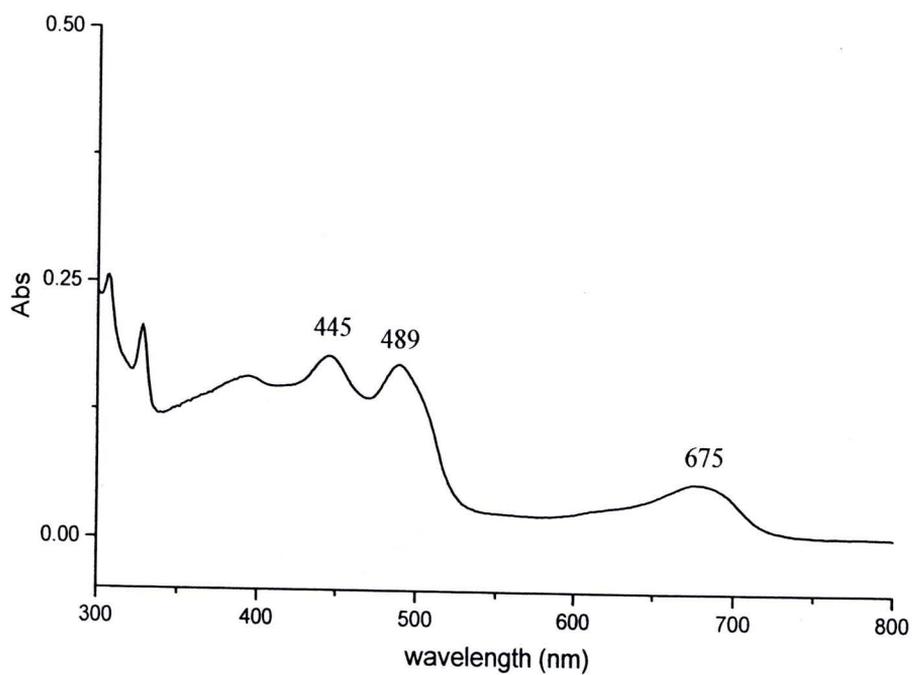


Figure A-81 The UV-visible spectrum of Mn-(PE)₂DMP (25)

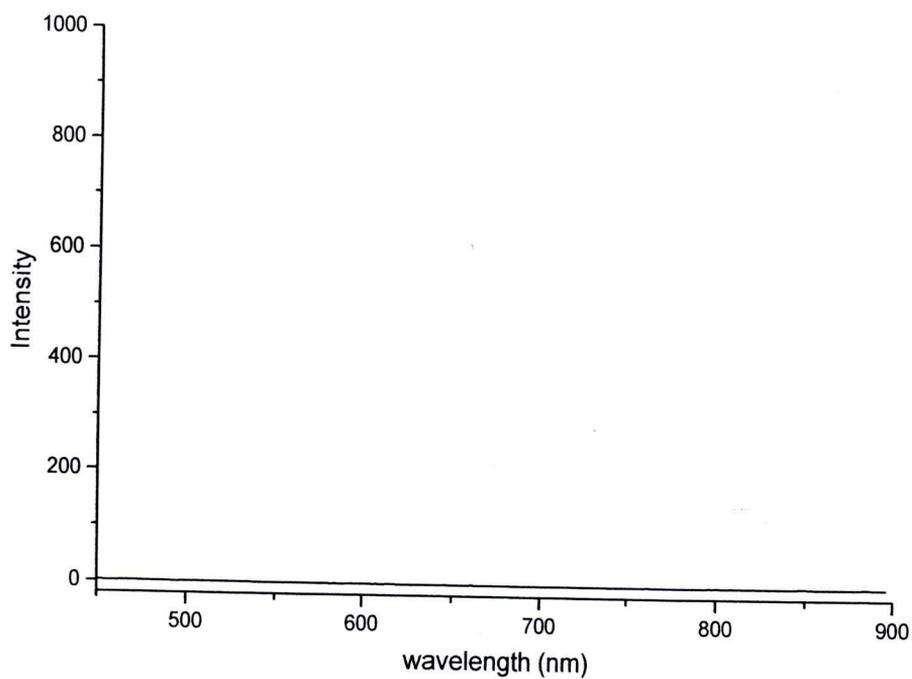


Figure A-82 The fluorescence spectrum of Mn-(PE)₂DMP (25)

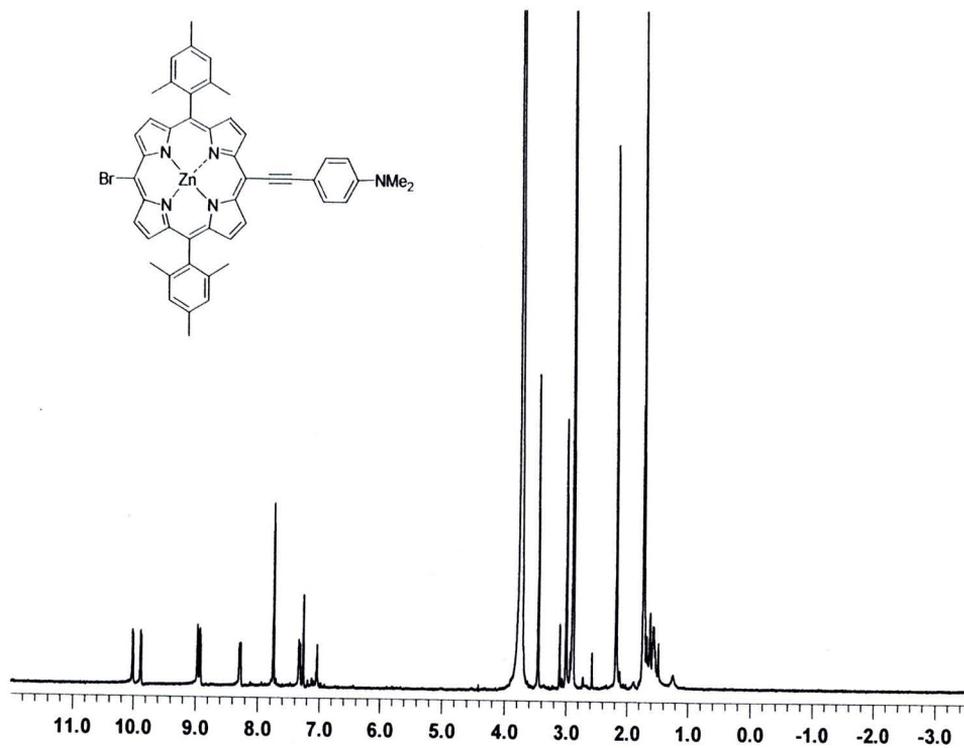


Figure A-83 The ^1H NMR spectrum of Zn-(DMAPE)(Br)DMP (**26**)

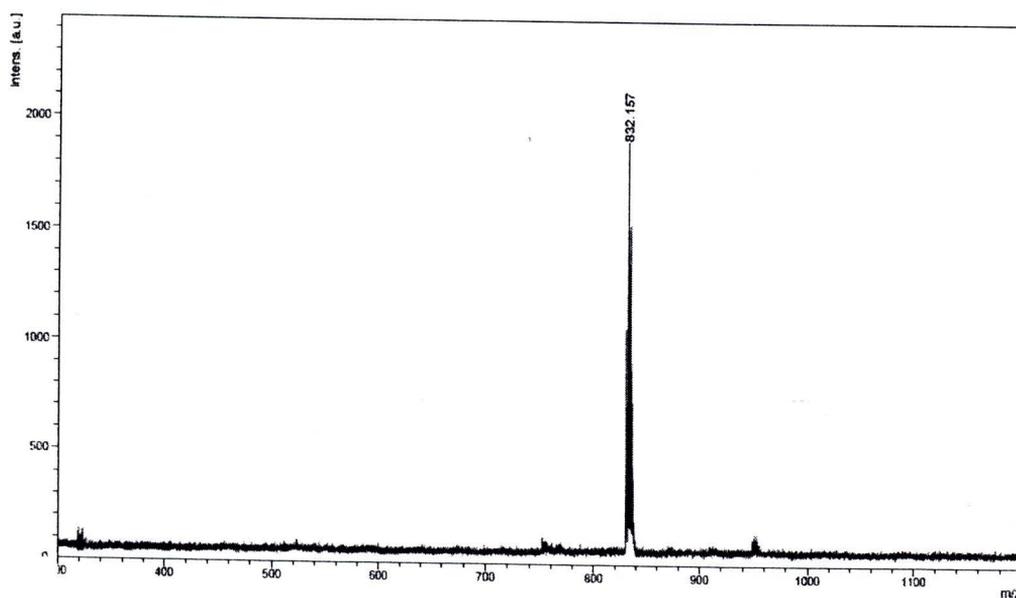


Figure A-84 The MALDI-TOF mass spectrum of Zn-(DMAPE)(Br)DMP (**26**)

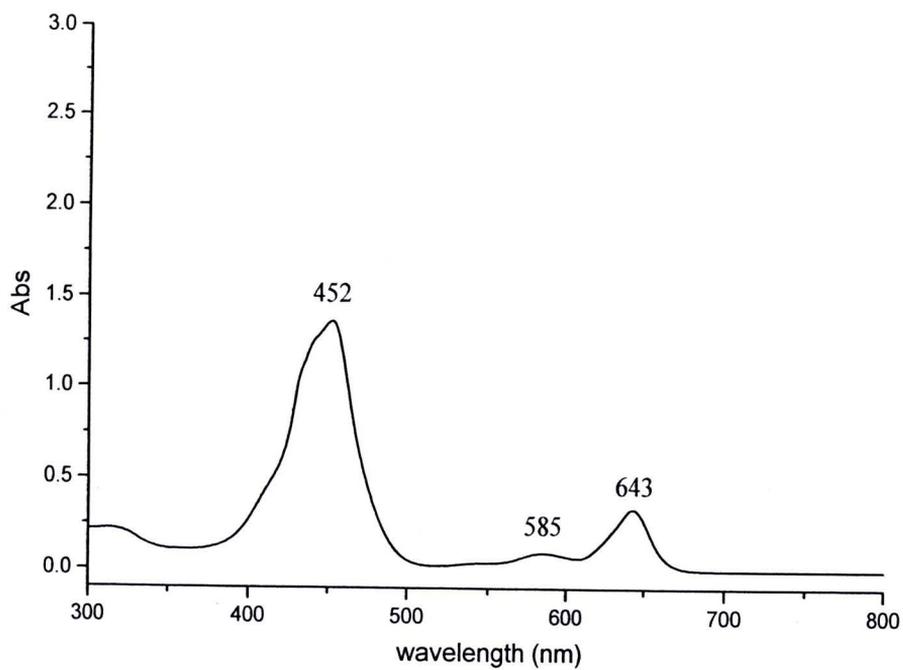


Figure A-85 The UV-visible spectrum of Zn-(DMAPE)(Br)DMP (26)

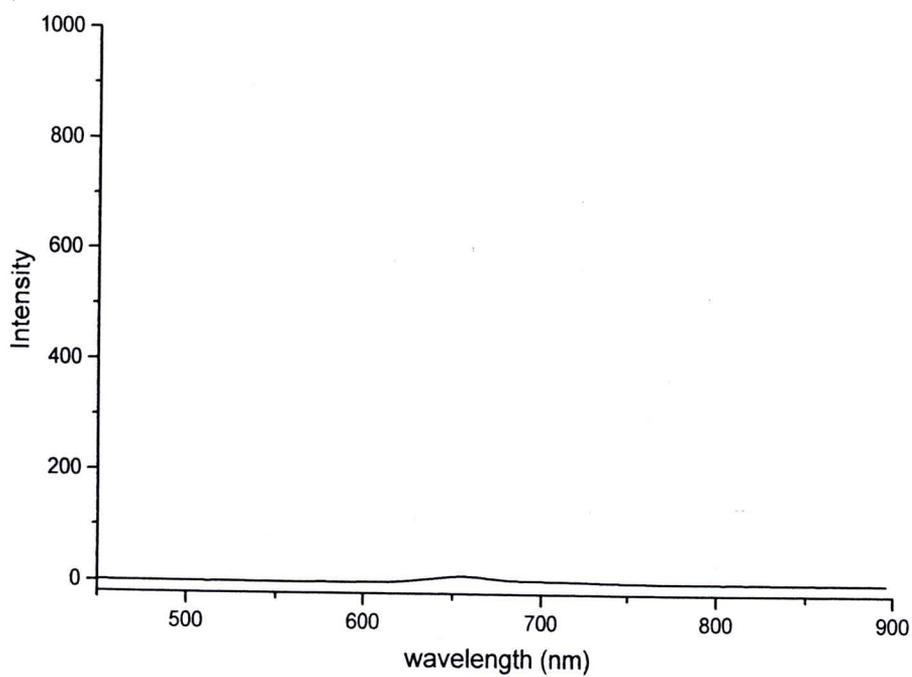


Figure A-86 The fluorescence spectrum of Zn-(DMAPE)(Br)DMP (26)

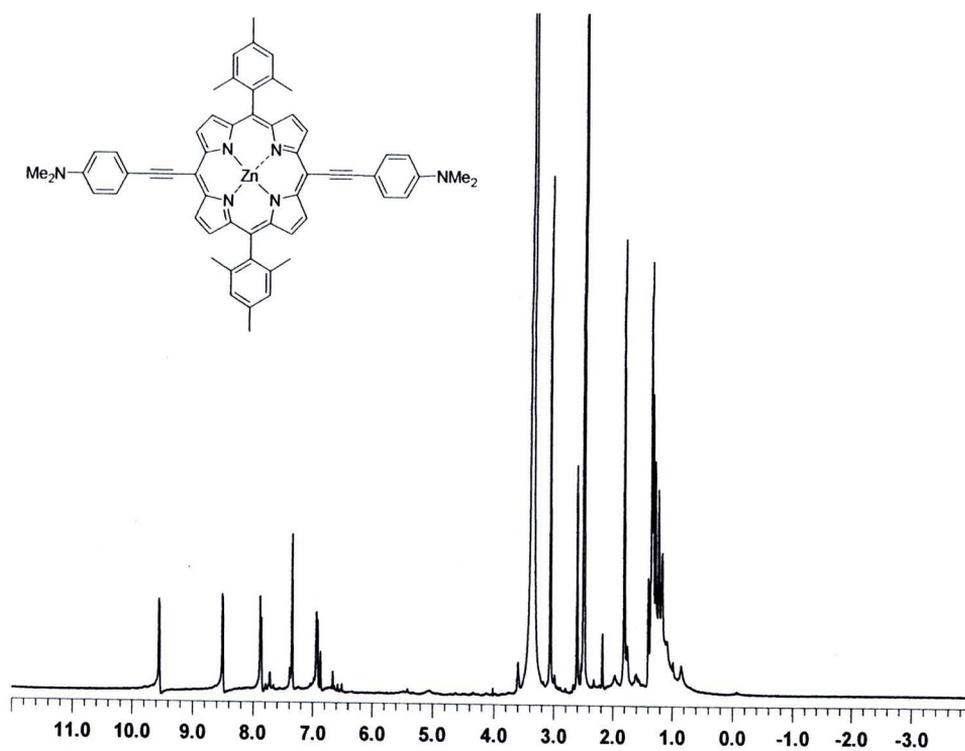


Figure A-87 The ¹H NMR spectrum of Zn-(DMAPE)₂DMP (27)

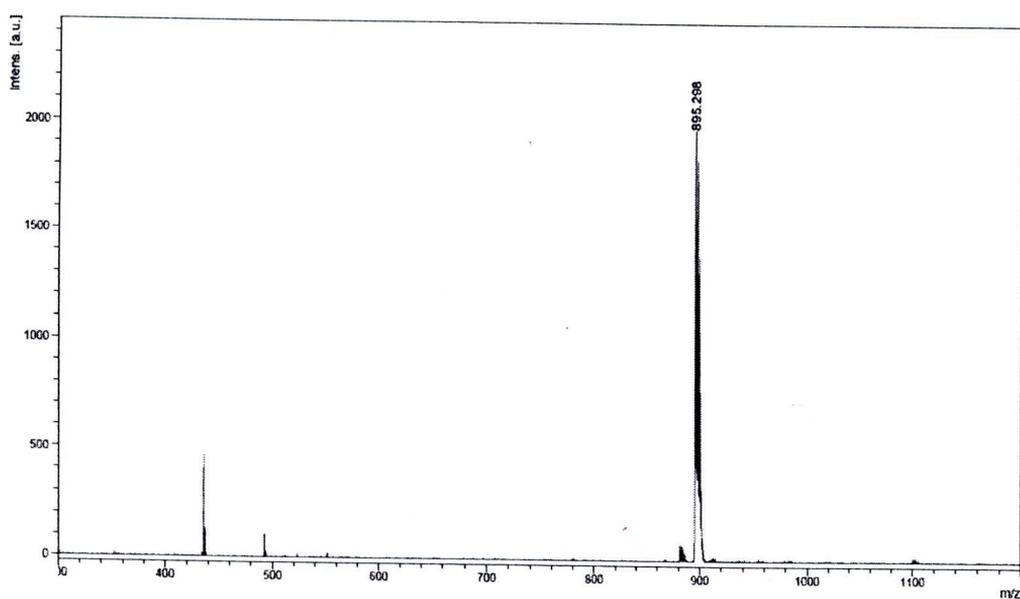


Figure A-88 The MALDI-TOF mass spectrum of Zn-(DMAPE)₂DMP (27)

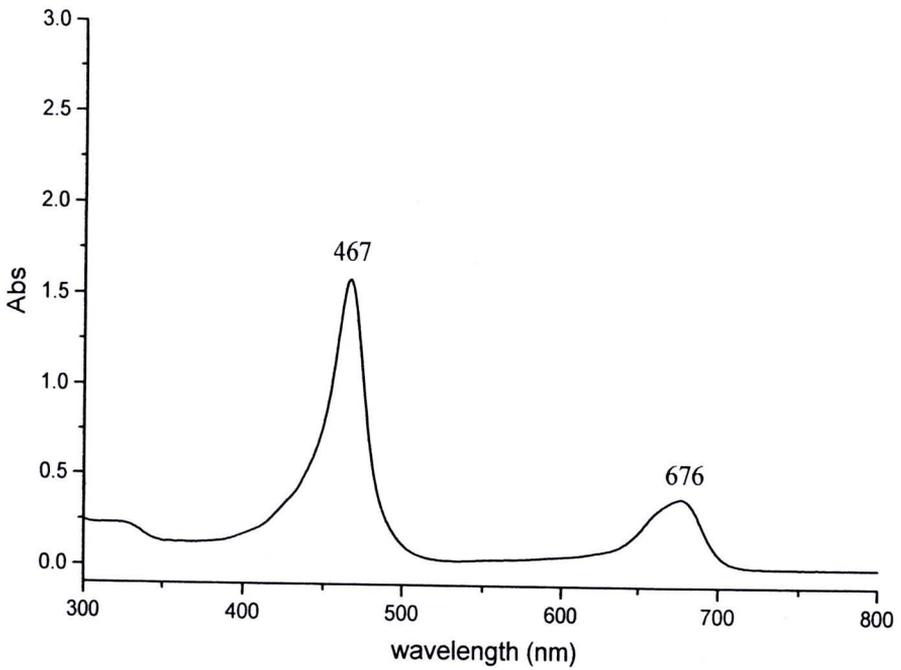


Figure A-89 The UV-visible spectrum of Zn-(DMAPE)₂DMP (27)

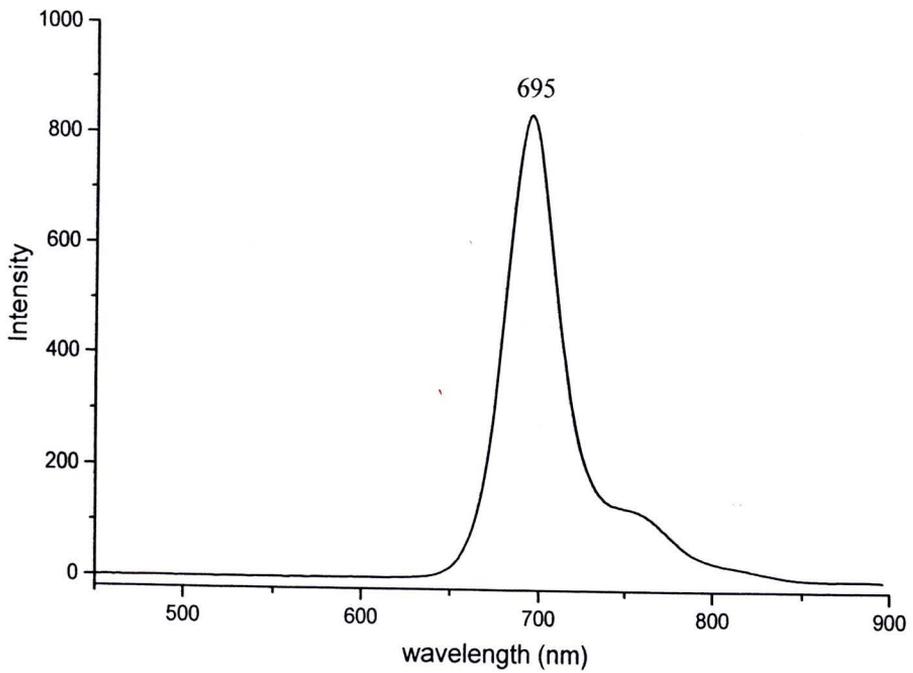


Figure A-90 The fluorescence spectrum of Zn-(DMAPE)₂DMP (27)

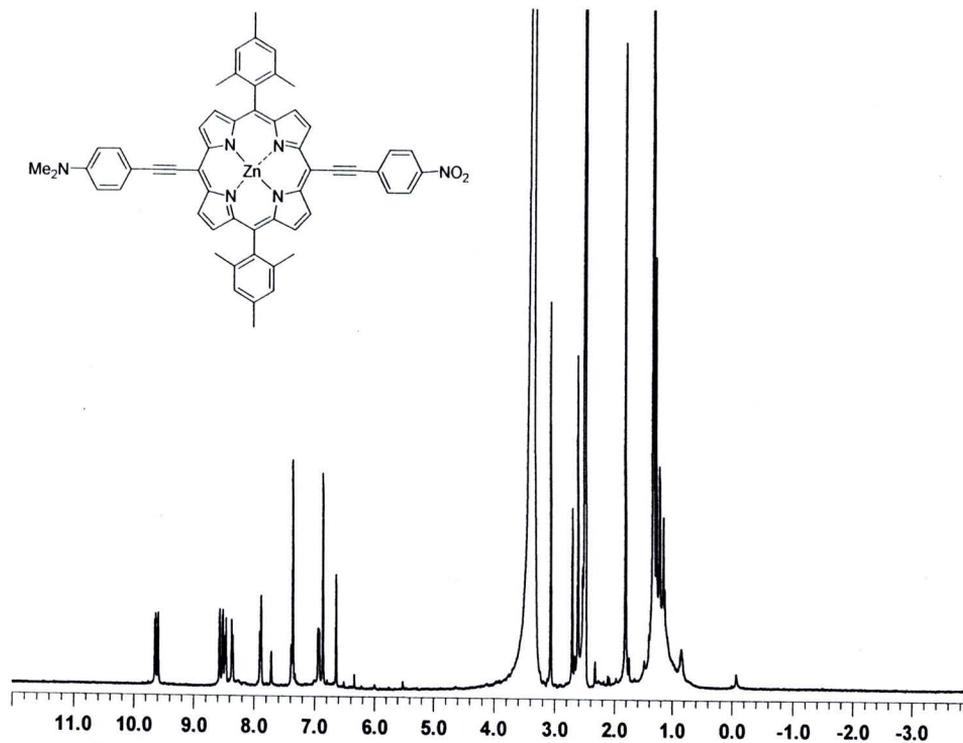


Figure A-91 The ^1H NMR spectrum of Zn-(DMAPE)(NPE)DMP (**28**)

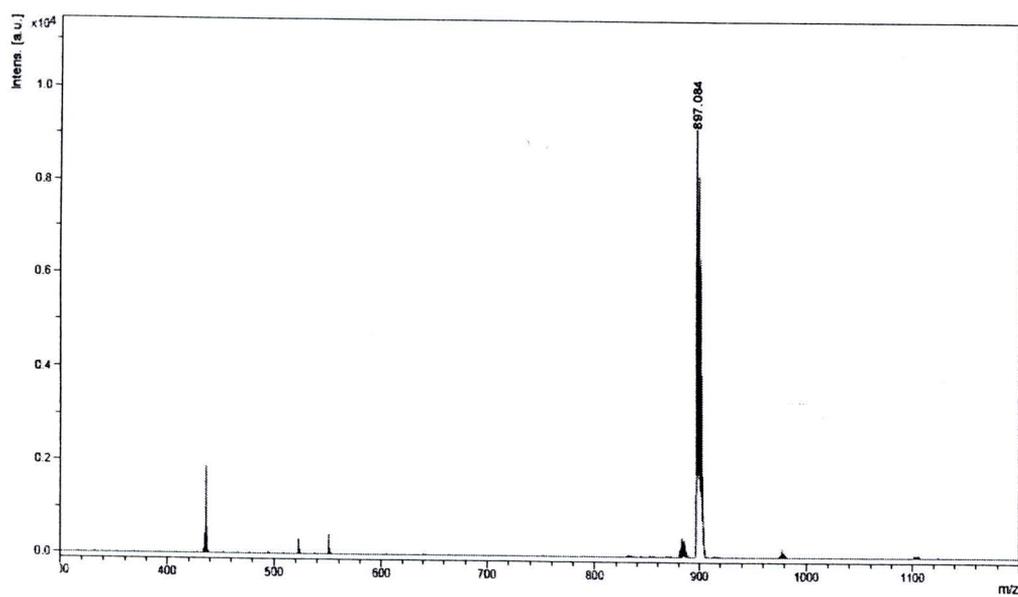


Figure A-92 The MALDI-TOF mass spectrum of Zn-(DMAPE)(NPE)DMP (**28**)

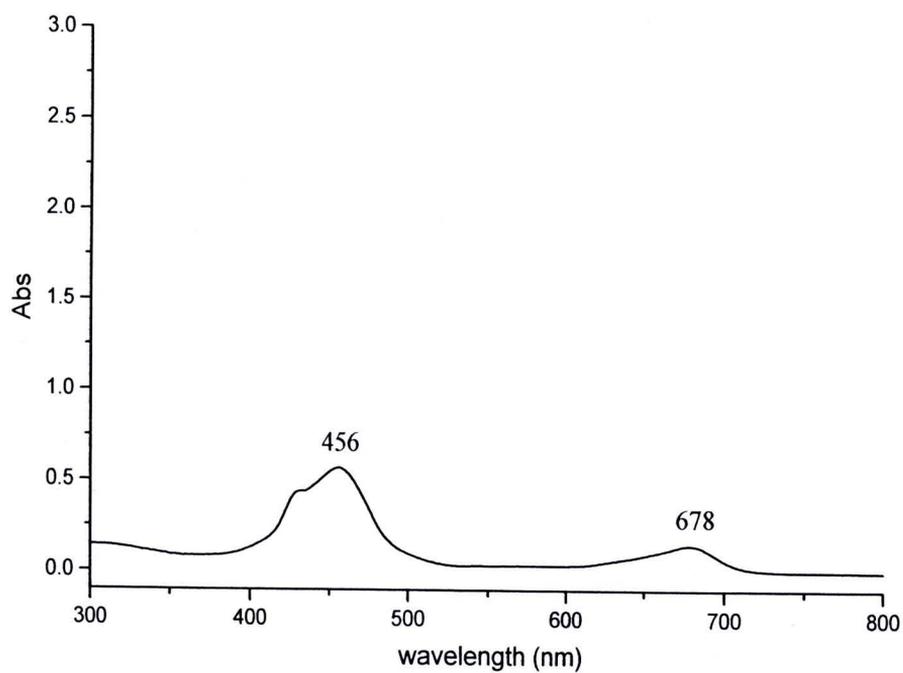


Figure A-93 The UV-visible spectrum of Zn-(DMAPE)(NPE)DMP (**28**)

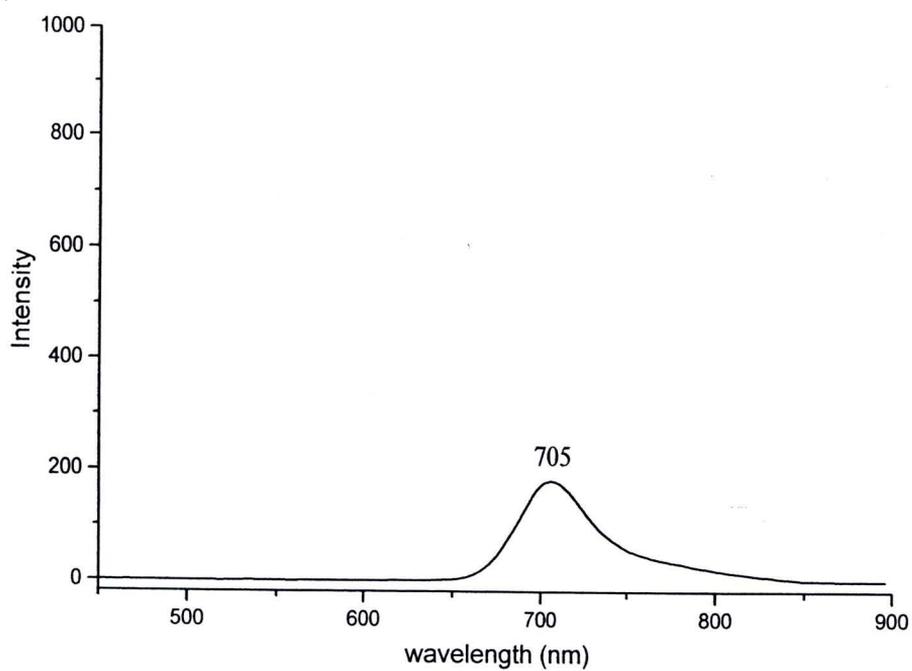


Figure A-94 The fluorescence spectrum of Zn-(DMAPE)(NPE)DMP (**28**)

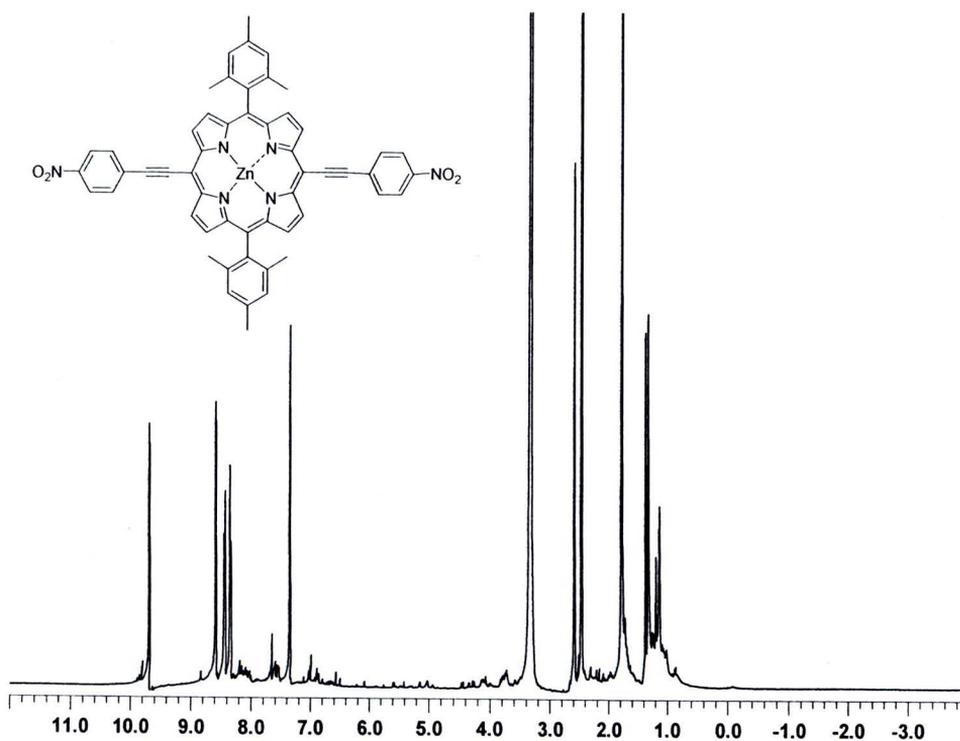


Figure A-95 The ¹H NMR spectrum of Zn-(NPE)₂DMP (29)

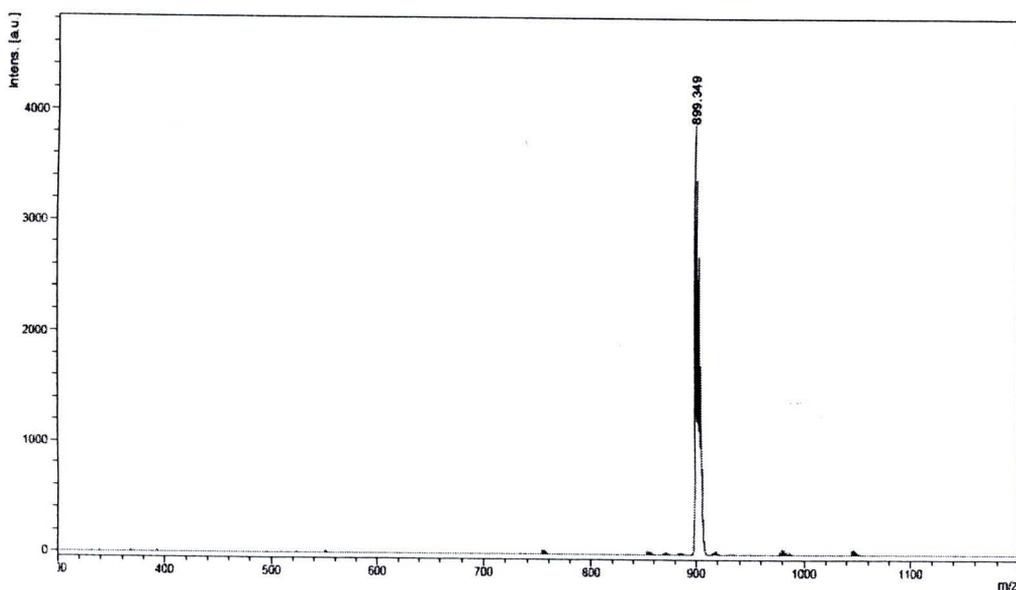


Figure A-96 The MALDI-TOF mass spectrum of Zn-(NPE)₂DMP (29)

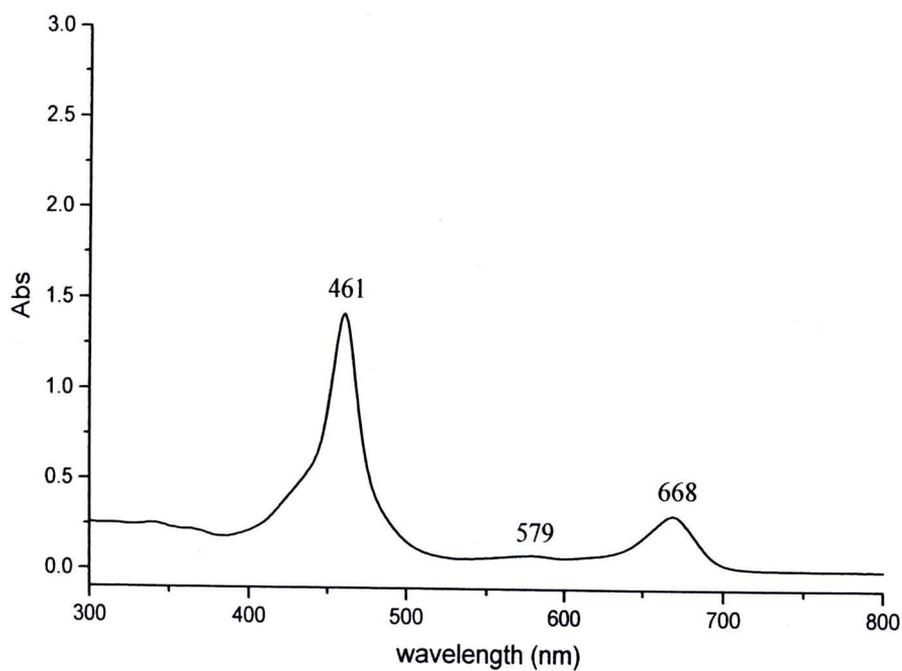


Figure A-97 The UV-visible spectrum of Zn-(NPE)₂DMP (29)

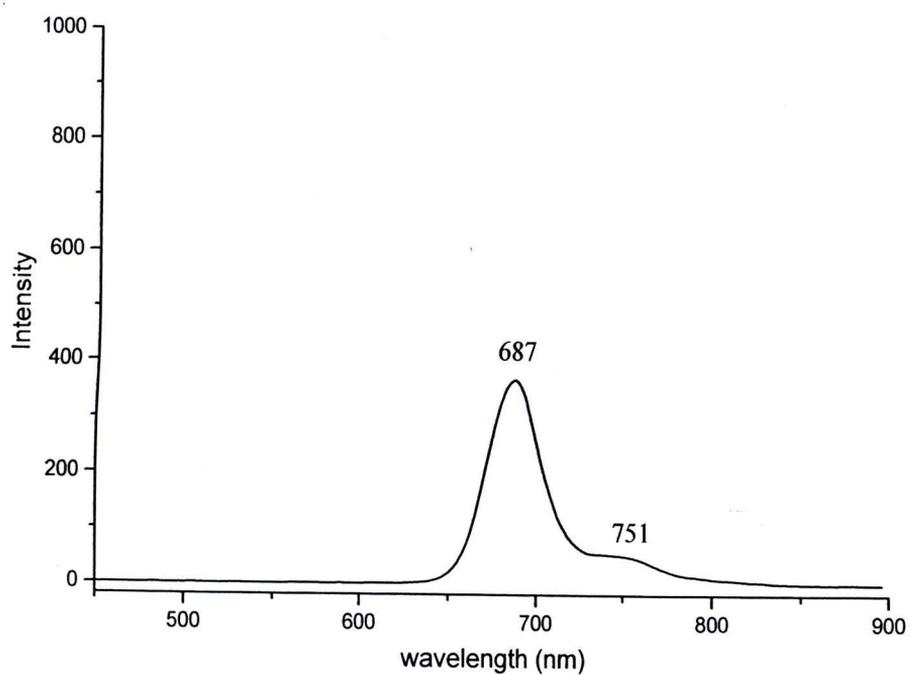


Figure A-98 The fluorescence spectrum of Zn-(NPE)₂DMP (29)

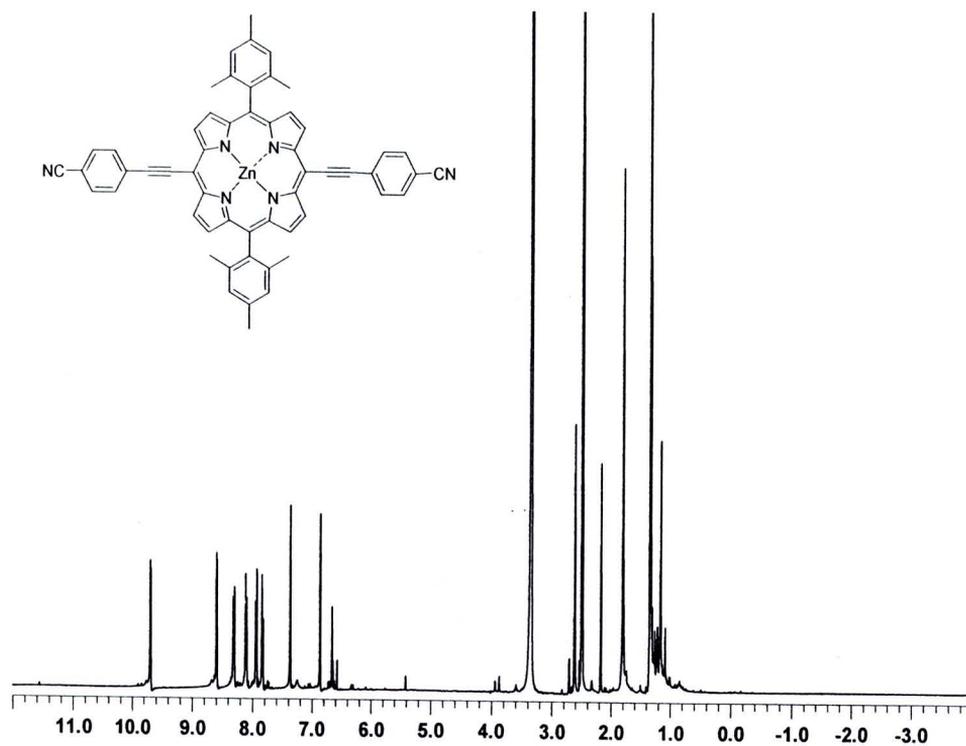


Figure A-99 The ¹H NMR spectrum of Zn-(CPE)₂DMP (30)

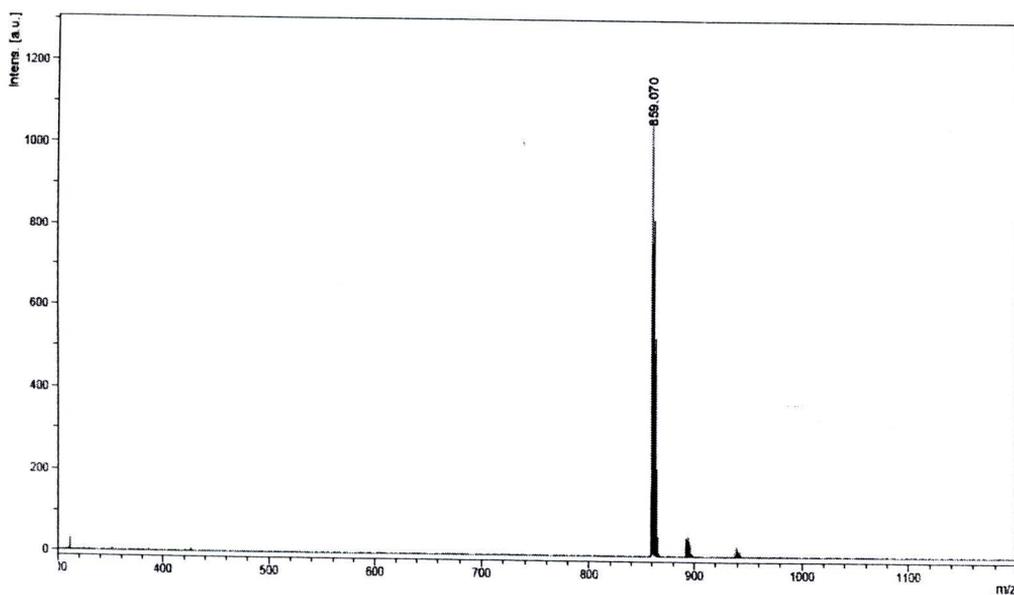


Figure A-100 The MALDI-TOF mass spectrum of Zn-(CPE)₂DMP (30)

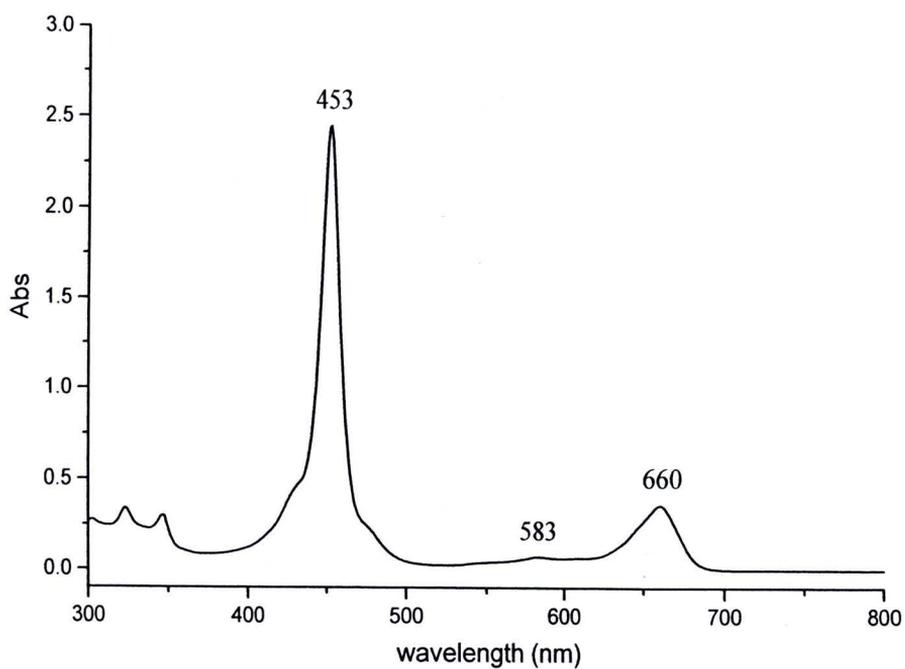


Figure A-101 The UV-visible spectrum of Zn-(CPE)₂DMP (30)

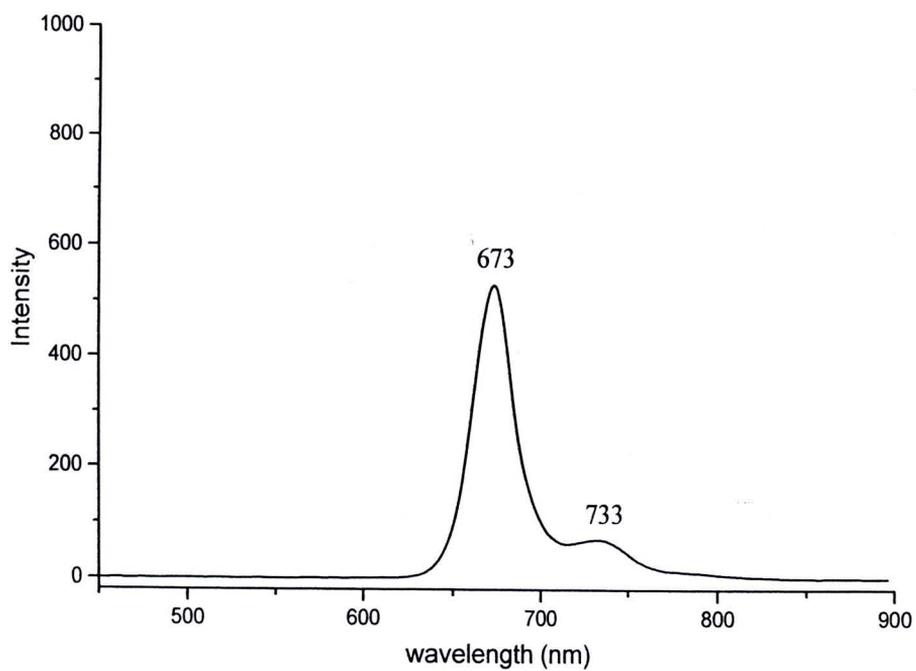


Figure A-102 The fluorescence spectrum of Zn-(CPE)₂DMP (30)

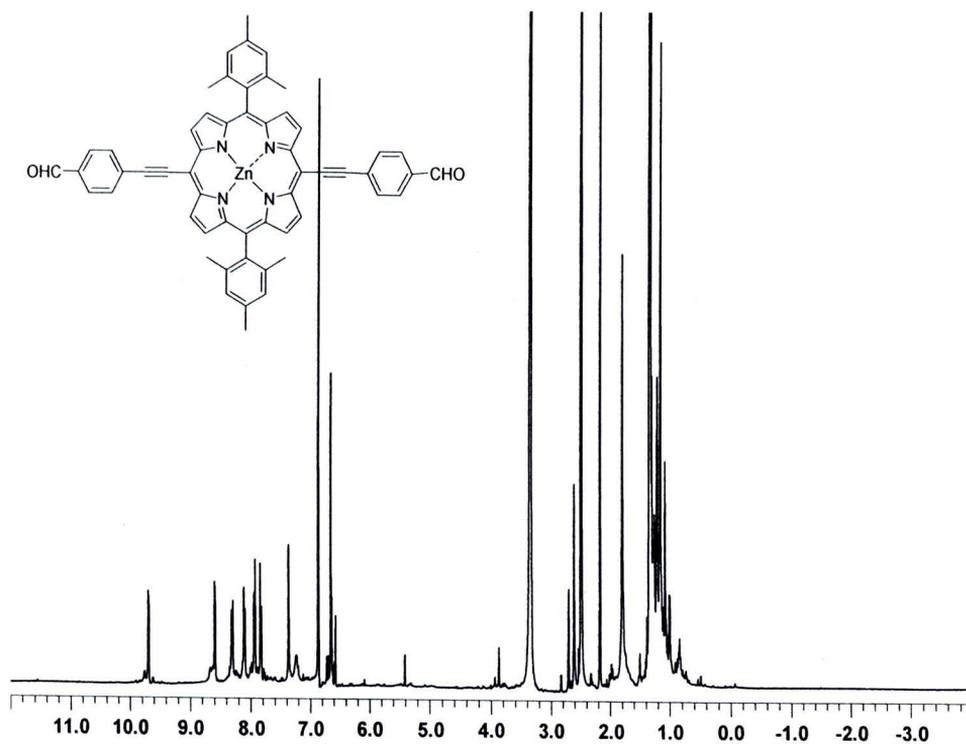


Figure A-103 The ¹H NMR spectrum of Zn-(FPE)₂DMP (31)

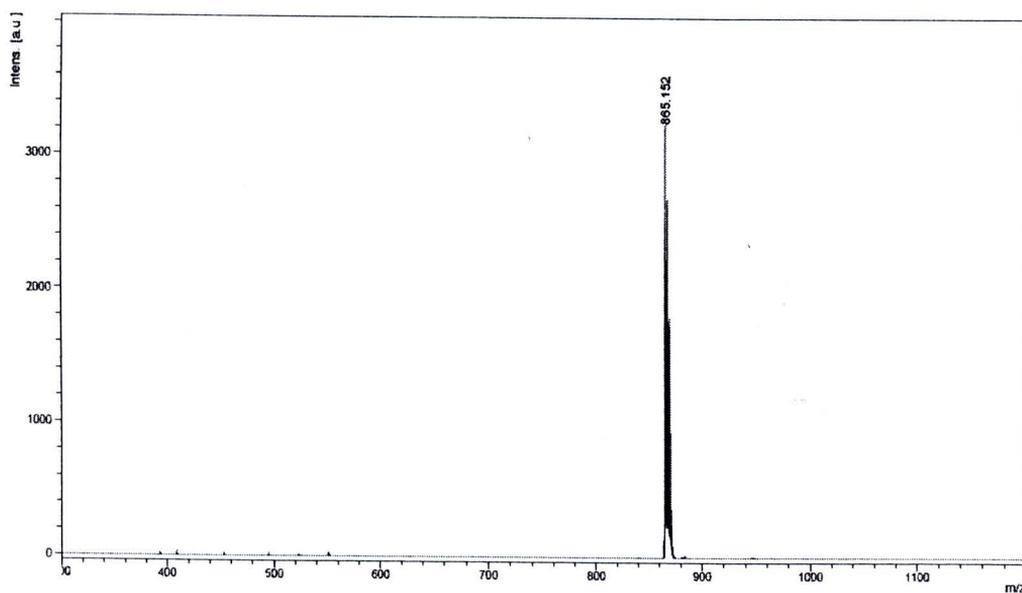


Figure A-104 The MALDI-TOF mass spectrum of Zn-(FPE)₂DMP (31)

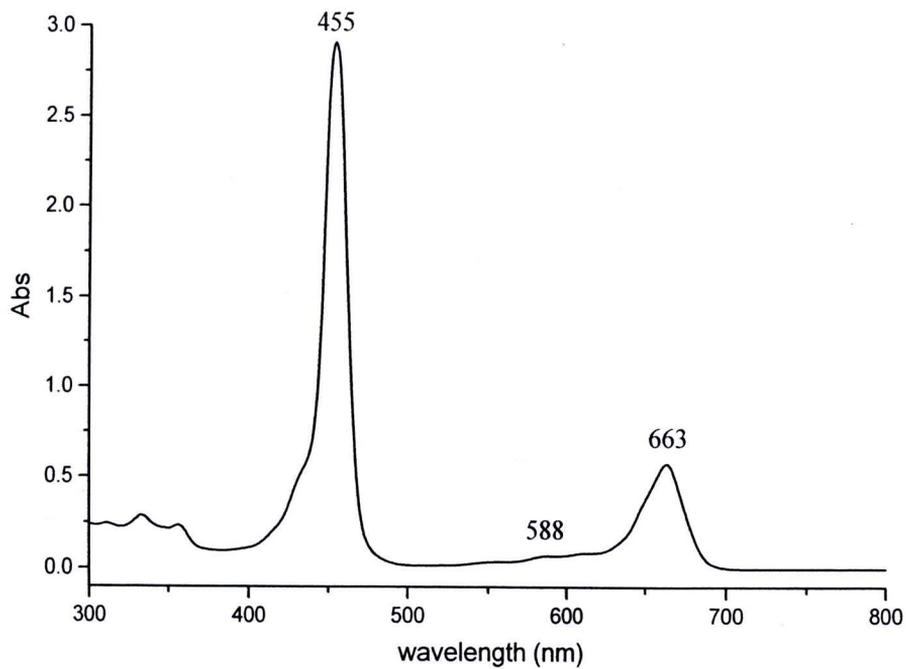


Figure A-105 The UV-visible spectrum of Zn-(FPE)₂DMP (31)

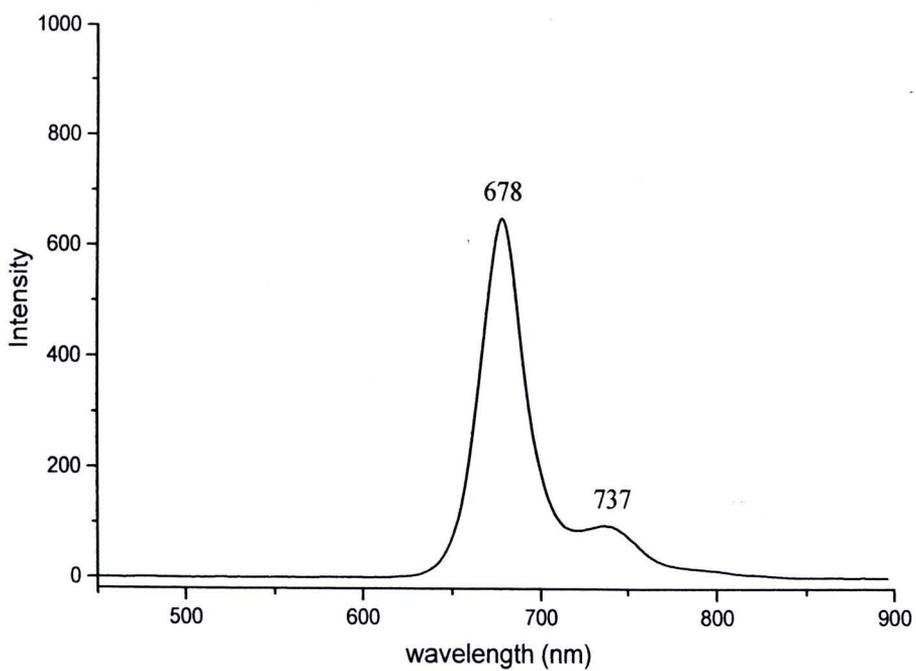


Figure A-106 The fluorescence spectrum of Zn-(FPE)₂DMP (31)

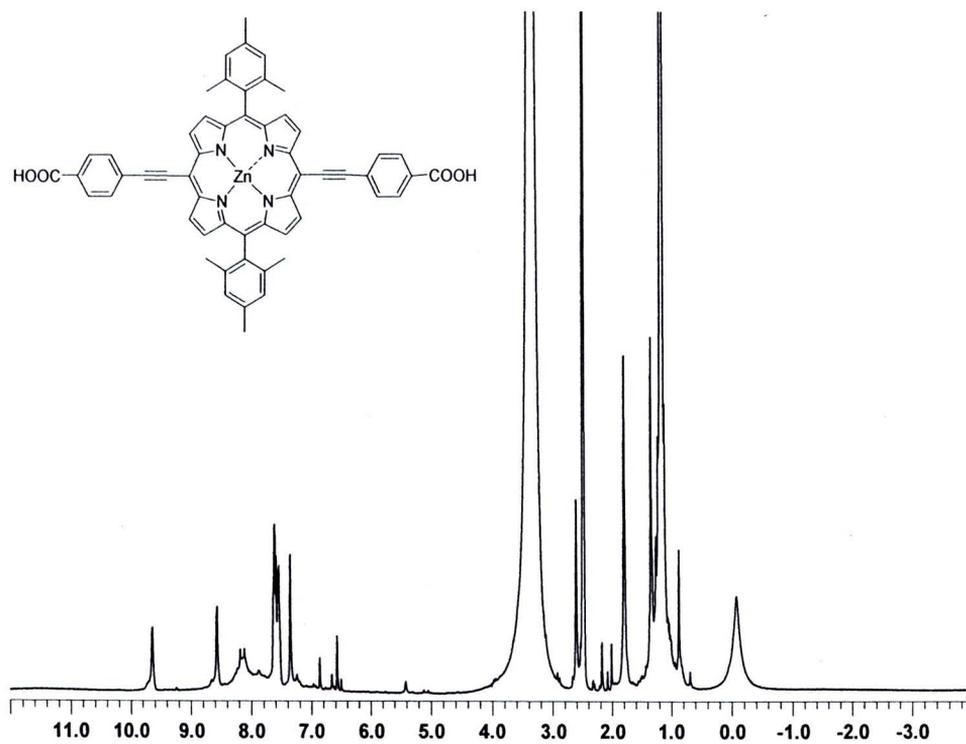


Figure A-107 The ¹H NMR spectrum of Zn-(CarPE)₂DMP (32)

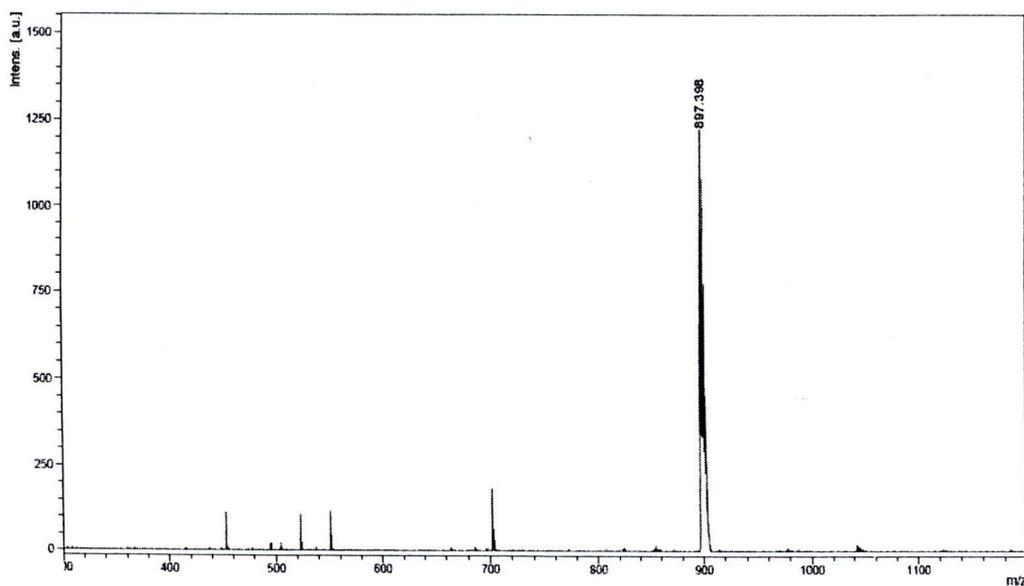


Figure A-108 The MALDI-TOF mass spectrum of Zn-(CarPE)₂DMP (32)

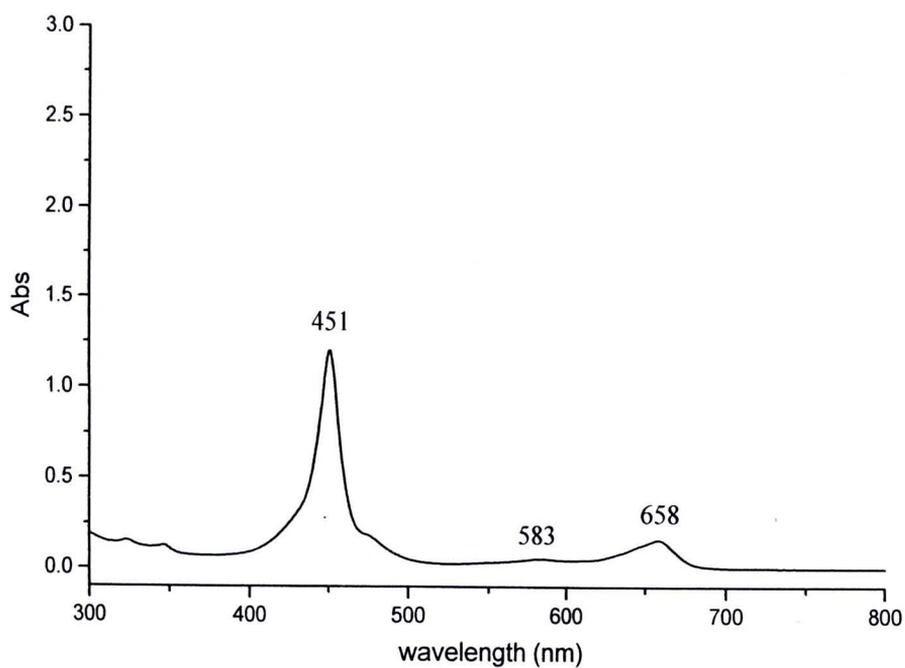


Figure A-109 The UV-visible spectrum of Zn-(CarPE)₂DMP (32)

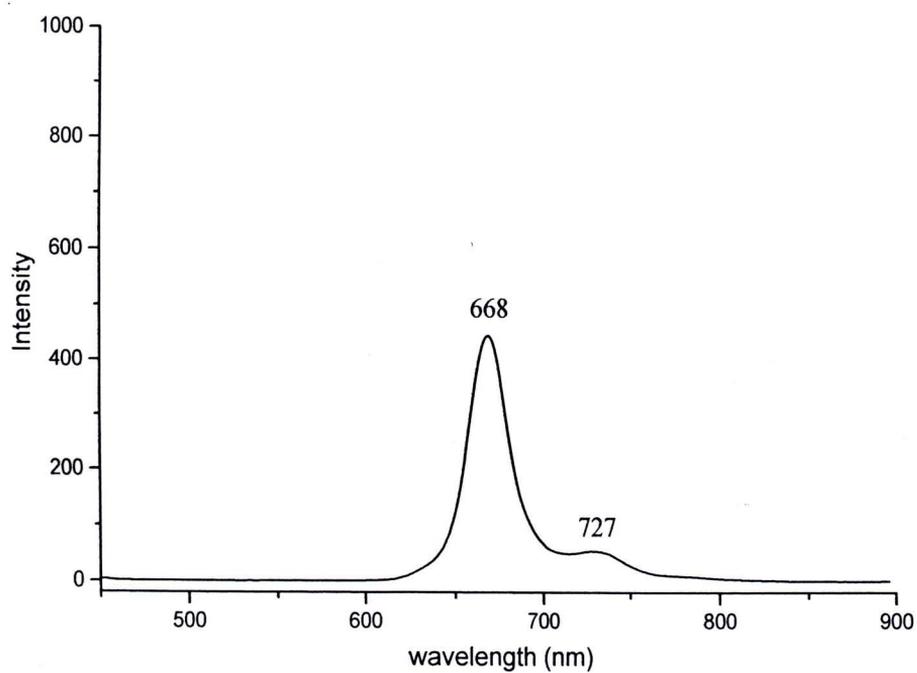


Figure A-110 The fluorescence spectrum of Zn-(CarPE)₂DMP (32)

VITAE

Mr. Wuttichai Reainthippayasakul was born on June 14th, 1984 in Bangkok, Thailand. He received a Bachelor Degree of Science, majoring in Chemistry from Faculty of Science, Chulalongkorn University in 2005. Since 2006, he has been a graduate student studying Organic Chemistry as his major course at Department of Chemistry, Faculty of Science, Chulalongkorn University. During his studies towards the Master's degree, he was awarded by Chulalongkorn University Graduate Scholarship to Commemorate the 72nd Anniversary of His Majesty King Bhumibol Adulyadej during 2006-2007.

His present address is 93 Soi Krungthep-Nonthaburi 23, Krungthep-Nonthaburi Rd., Bangsue, Bangkok, Thailand 10800, Tel. (02)-5858469.



