Benzene–Naphthalene Copolymer as a Processible Conductive Polymer

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The synthesis of a processible benzene–naphthalene copolymer and its potential use as battery electrode material are reported.

A number of aromatic compounds have been employed recently to produce conducting or semi-conducting polymers;[1] however, only a few, such as poly-*p*-phenylene sulphide, are processible.[2]

We report here the preparation of a benzene–naphthalene copolymer by the popular Kovacic method,[3] using anhydrous $AlCl_3$ as the Lewis-acid catalyst and anhydrous $CuCl_2$ as the oxidizing agent. Mechanical stirring of a heterogeneous mixture of naphthalene (0.2 mol), benzene (0.8 mol), anhydrous $AlCl_3$ (0.5 mol), and anhydrous $CuCl_2$ (0.5 mol) on dropwise addition of 1 ml of water at a constant temperature of 35 $\pm$ 0.1 °C for two hours yielded a brown-black polymer (70%) which was soluble in organic solvents such as benzene, chloroform, toluene, carbon tetrachloride, *etc.* A decrease in solubility was observed with increasing polarity of the solvent.

The polymer displays a glass transition temperature at 65 °C. Films of the polymer could be cast on glass slides and various other substrates, which, on drying could be peeled off.

The polymer shows intense u.v.-visible absorption [$\lambda_{max.}$ (C_6H_6) 280 nm (log ε 4.50) and 316.5 (log ε 4.36)]. The i.r. spectrum shows prinicipal bands at 1590, 1480, 1000, 940, 810, 780, 740, and 700 cm^{-1}. The absence of bands at 710 and 690 cm^{-1} prompts us to suggest that the end groups of the polymer chain may be naphthyl rings rather than phenyl. The virgin polymer shows a very low conductivity (10^{-10} ohm^{-1} cm^{-1}). However doping with bromine leads to an increase in conductivity by almost 4 orders of magnitude to 10^{-5}—10^{-6} ohm^{-1} cm^{-1}. Similarly, experiments on electrochemical doping in acetonitrile containing anhydrous $NaClO_4$ were carried out on films cast on glass slides; the conductivity was found to increase to 10^{-2} ohm^{-1} cm^{-1}.

Preliminary studies indicate that the polymer has potential for use as electrode material in secondary batteries, as an electrostatic dissipation agent, and as an effective electromagnetic interference shielding agent.

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