“Synthesis and Characterization of Novel Conducting PMMA-based Polymer via In Situ Free Radical Polymerization in Ionic Liquid for Electrochemical Devices”

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Poly(methyl methacrylate) (PMMA) is a transparent thermoplastic and often used as an alternative to glass. In 1985, for the first time, it had been used as electrolyte material and was found to show stability towards lithium electrode. However, this can only be achieved if it is being fabricated into thin film form. To date fabricating PMMA film is a challenge since commercial PMMAs produced brittle films due to their polar nature that prone to form interchain crosslinking via hydrogen bonding. Therefore, in this project, the opportunity of the PMMA chains to form hydrogen bonding was hindered by incarceration of 1-methyl-3-pentamethyldisiloxymethylimidazolium bis(trifluoromethylsulfonyl)imide, $[(SiOSi)C_1C_1im][NTf_2]$ during free radical polymerization of MMA. Interestingly, this newly synthesized PMMA containing IL ($PMMA_{IL}$) produced flexible and transparent films with ionic conductivity of ~10^{-7} S cm^{-1}. The ionic conductivity of $PMMA_{IL}$ was further enhanced by the addition of lithium triflate (LiTf) as the additional conducting species. As the result, the ionic conductivity of this doped $PMMA_{IL}$ films was successfully enhanced up to ~10^{-4} S cm^{-1}. This $PMMA_{IL}$/LiTf film was then fabricated into EDLC-type supercapacitors. It was found that this fabricated cell exhibits specific capacitance of 20.68 F g^{-1} with cyclic durability more than 106 cycles. The energy density and power density obtained were 0.82 Wh kg^{-1} and 23.04 kW kg^{-1} respectively and these values fits the minimum requirement for application in supercapacitors.

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