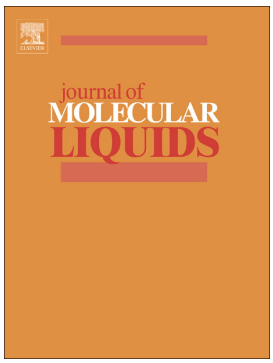

1-Allyl-3-methylimidazolium-based ionic liquids employed as suitable electrolytes for high energy density supercapacitors based on graphene nanosheets electrodes

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1-allyl-3-methylimidazolium-based ionic liquids employed as suitable electrolytes for high energy density supercapacitors based on graphene nanosheets electrodes.

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Abstract

The preparation of a series of novel low viscosity 1-allyl-3-methylimidazolium ionic liquids (ILs) is performed following dedicated synthetic routes. The physico-chemical properties of resulting molecular solvent-free ILs (true ILs) are investigated and discussed systematically toward the anion constituents. Herein, six electrolytes are studied including one planar structured anion (DCA^-) and five anions presenting non-planar structures (PF_6^-, $TFSI^-$, BF_4^-, TFA^- and OTf^-). The as-prepared ILs are employed as green electrolytes for symmetric electrochemical double layer capacitors (EDLCs) based on graphene nanosheets (GNS) electrodes. The EDLC devices deliver specific capacitances ranging from 135 to 228 $F.g^{-1}$, and suitable energy densities, ranging from 41 to 115 $Wh.kg^{-1}$. An electrochemical stability of 94 % is reached upon 1000 charge/discharge cycles over a large cell voltage window (3-4 V) with a quasi-ideal capacitive behaviour. Among the studied ILs, 1-allyl-3-methylimidazolium dicyanmide (AMIM-DCA) exhibit the highest specific capacitance and the maximum energy density. Such a performance is attributed to the compatibility between the channel-based 2-D graphene network and the planar structure of AMIM-DCA. The resulting AMIM-DCA/GNS interface facilites the reversible adsorption/desorption process of electrolyte ions during the charge storage. Accordingly, the studied EDLC cells are promising candidates for high-capacity and high-reliability energy-storage applications.

Keywords: Ionic liquids; Imidazolium; Transport properties; Graphene; Supercapacitors; Energy Storage.