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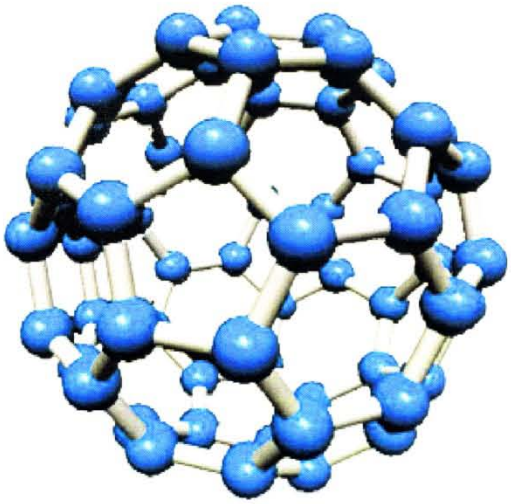

Synthesis and characterization of novel thiazolium-based room temperature ionic liquids for supercapacitor applications

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Abstract

Thiazolium bis(trifluoromethanesulfonyl)imide ionic liquids, having different substituents in the 3,4,5 positions of the thiazole ring, have been synthesized. Thermal analysis data indicate that the thiazolium bis(trifluoromethanesulfonyl)imide ionic liquids under study have low melting temperature, which makes them liquid at room temperature, and a decomposition temperature close to 300ºC, in both inert and oxidant atmospheres. Ionic conductivity vs. temperature graphs show in all cases a VTF behaviour, consistently observed for ionic liquids. Room temperature conductivity of all samples was of the order of 10^{-3} S.cm^{-1}.

Keywords: *Thiazole, ionic liquids, supercapacitors*

1 Introduction

Supercapacitors are electrochemical devices, able to store energy either by a pure electrostatic attraction occurring between the ions and the charged surface of the electrode (EDLC), or by fast surface Faradaic redox reactions (pseudocapacitor). Room temperature ionic liquids (RTILs), consisting of an organic cation (quaternary ammonium, pyridinium, pyrrolidinium, pyrazolium, piperidinium, imidazolium) and an inorganic anion (Br^-, $TFSI^-$, BF_4^-, PF_6^-) are promising electrolytes in supercapacitors due to their large electrochemical windows, high ionic conductivities, high chemical and thermal stability, non-flammability and negligible vapor pressure. In this work we report on the synthesis and characterization of novel thiazole-based room temperature ionic liquids for supercapacitor applications.

2 Experimental

Thiazolium bis(trifluoromethanesulfonyl)imide ionic liquids having different substituents in the 3,4,5 positions of the thiazole ring were synthesized from 4-methhyl-5-tiazoethanol in three steps (O-alkylation, N-alkylation of the O-protected ring and finally the metathesis of the halide by the anion). Thermal gravimetric analysis (TGA) of the samples was performed on a TA Q500 instrument under nitrogen oxygen flow and a heating rate of 10º C/min. Thermal transitions were studied by using a Mettler TA4000 differential scanning calorimeter. The ionic conductivity of the samples was measured from -20º C to 100ºC over the frequency range 10^{-1}-10^{7} Hz using a Novocontrol Alpha analyzer in combination with a Novocontrol Quatro temperature controller

3 Results

Thermal analysis data indicate that the thiazolium bis(trifluoromethanesulfonyl)imide ionic liquids under study have low melting temperature, which makes them liquid at room temperature, and a decomposition temperature close to 300ºC, in both inert and oxidant atmospheres, differences being only detected due to the degradation of the side chain groups. Ionic conductivity values, calculated from the Nyquist plots by using the ZPlot fitting software, vs. temperature graphs show in all cases a VTF behaviour, consistently observed for several different ionic liquids. Room temperature conductivity of all samples was of the order of 10^{-3} S.cm^{-1}.

4 Conclusions

Thiazolium bis(trifluoromethanesulfonyl)imide ionic liquids having different substituents in the 3,4,5 positions of the thiazole ring have been synthesized. Data obtained from thermal and ionic conductivity measurements indicate that the synthesized ionic liquids fulfil the requirement needed to be potentially used as electrolytes in supercapacitors technology.

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