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The effect of Al_2O_3 nano-filler on ion interactions in ionic liquid based electrolytes using vibrational spectroscopy

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Ionic liquid (IL) based electrolytes are considered as safer electrolytes for future rechargeable batteries due to their non-volatility and non-flammability. To make them as electrolytes, suitable salts should be added. Lithium salts doped ILs have been studied up to a great extent, however, studies on incorporation of other salts based on sodium (Na) or magnesium (Mg) into ILs are lacking. Since ion transport properties such as ionic conductivity of these IL-salt mixtures depends on the molecular structure and interactions, observations of spectroscopic studies may help to develop these materials. In this work, ionic interactions of sodium triflate (NaTf) and magnesium triflate (MgTf) doped IL system based on 1-butyl-3-methylimidazolium trifluromethanesulfonate (BMIMTf) and alumina (Al_2O_3) nano-filler are explored by FTIR spectroscopy. The liquid electrolytes were prepared by adding a molar fraction (x = 0.1) of each salt in to IL. The 10 wt% of Al_2O_3 nano-fillller was added to each IL-salt mixture to investigate the change of solvation structure. The results clearly showed that the addition of Al_2O_3 nano-filler in to BMIMTf/NaTf mixture has a clear effect on ion interaction reducing ion-IL coordination. However, solvation structure of BMIMTf/MgTf system does not changed significantly with the addition of nano-filler. This indicates that the Al_2O_3 nano-filler is more favored to interact with monovalent cation (Na^+) rather than divalent cation (Mg^{2+}). These findings will guide experimentalists in optimizing IL-based electrolyte materials, which may enable the application of IL-based electrolytes in novel energy-storage technologies.

Keywords: Electrolytes, Ionic liquid, Nanofiller, FTIR spectroscopy

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