Preferential Solvation within Binary and Ternary Solutions Containing Room-Temperature Ionic Liquids

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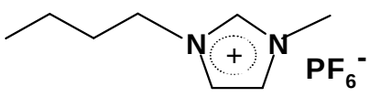
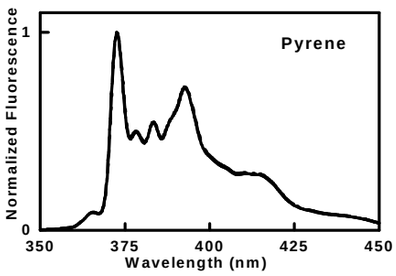
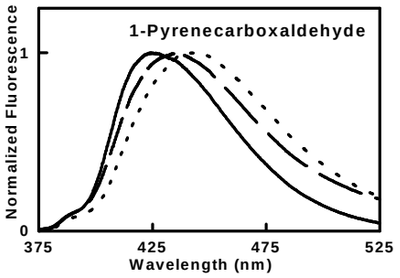
Room-temperature ionic liquids (RTILs) show tremendous promise as replacements for harmful organic solvents currently in use. Although it has been shown that RTILs have promise in synthesis, catalysis, separation and extraction processes, relatively little information is known about these potentially environmentally-benign solvent systems. Therefore, before such RTILs can be utilized on an industrial scale, information regarding their relative polarity as well as the affects of added cosolvents needs to be better understood. Towards this end, the dipolarity of several ionic liquids is investigated using select absorbance (Reichardt's betaine dye) and fluorescence (pyrene, 1-pyrenecarboxaldehyde, Nile Red and dansylamide) probes. In addition, the preferential solvation of Reichardt's betaine dye, pyrene, 1-pyrenecarboxaldehyde and 1,3-bis(1-pyreneyl)propane within ionic liquid-organic solvent, ionic liquid-water and ionic liquid-ionic liquid binary and ionic liquid-based ternary solvent mixtures is reported. Our investigation with a common RTIL 1-butyl-3-methylimidazolium hexafluorophoshate, BMIM PF_6, with added water (select data presented here) has indicated preferential solvation for the solvatochromic probes pyrene and 1-pyrenecarboxaldehyde.



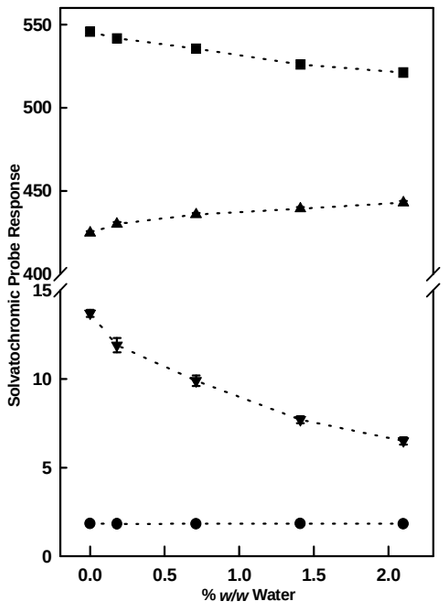
Molecular structure of RTIL BMIM PF_6.



Emission spectra of 10 µM pyrene dissolved in neat BMIM PF_6 (dark lines), 0.71% *w/w* water in BMIM PF_6 (dashed lines), and 2.10% *w/w* water in BMIM PF_6 (dotted lines).



Solvatochromic probe response for pyrene (I_I/I_{III} values, ●), Reichardt's betaine dye ($\lambda_{max}^{absorbance}$ in nm, ■), 1-pyrenecarboxaldehyde ($\lambda_{max}^{fluorescence}$ in nm, ▲), and 1,3-*bis*-(1-pyrenyl)propane (I_M/I_E values, ▼) in water + BMIM PF_6 solutions.



Emission spectra of 10 µM 1-pyrenecarboxaldehyde dissolved in neat BMIM PF_6 (dark lines), 0.71% *w/w* water in BMIM PF_6 (dashed lines), and 2.10% *w/w* water in BMIM PF_6 (dotted lines).