

Photophysical Study of Pyrene Butyric Acid in Aqueous Ionic Liquid

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Abstract : Ionic liquids (ILs) are molten salts, consist predominantly of ions and found to be liquid below 100°C. The unparalleled growing interest in ILs is based upon their never ending design flexibility. The use of ILs as a co-solvent in binary as well as a ternary mixture with molecular solvents multifold its utility. Since polarity is one of the most widely applied solvent concepts which represents simple and straightforward means for characterizing and ranking the solvent media, its study for a binary mixture of ILs is crucial for its widespread application and development. The primary approach to the assessment of solution phase intermolecular interactions, which generally occurs on the picosecond to nanosecond time scales, is to exploit the optical response of photophysical probe. Pyrene butyric acid (PBA) is used as fluorescence probe due to its high quantum yield, longer lifetime and high solvent polarity dependence of fluorescence spectra. Propylammonium formate (PAF) is the IL used for this study. Both the UV-absorbance spectra and steady state fluorescence intensity study of PBA in different concentration of aqueous PAF, reveals that with an increase in PAF concentration, both the absorbance and fluorescence intensity increases which indicate the progressive solubilisation of PBA. Whereas, near about 50% of IL concentration, all of the PBA molecules get solubilised as there are no changes in the absorbance and fluorescence intensity. Furthermore, the ratio II/IV, where the band II corresponds to the transition from S1 ($\nu = 0$) to S0 ($\nu = 0$), and the band IV corresponds to transition from S1 ($\nu = 0$) to S0 ($\nu = 2$) of PBA, indicates that the addition of water into PAF increases the polarity of the medium. Time domain lifetime study shows an increase in lifetime of PBA towards the higher concentration of PAF. It can be attributed to the decrease in non-radiative rate constant at higher PAF concentration as the viscosity is higher. The monoexponential decay suggests that homogeneity of solvation environment whereas the uneven width at full width at half maximum (FWHM) indicates there might exist some heterogeneity around the fluorophores even in the water-IL mixed solvents.

Keywords : fluorescence, ionic liquid, lifetime, polarity, pyrene butyric acid

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