Ionic Liquids Induce Surfactant-free Self-assembly

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As molten salts, ionic liquids (ILs) have huge potential in material and colloid science for their tuneable properties with different combinations of cations and anions. To date, almost all studies on IL-containing microemulsions involve a surfactant, which itself can form micellar structures in water. While ILs share with water the rare ability to promote surfactant self-assembly, the fundamental yet remarkable difference is the amphiphilic character of neat ILs [1-2]. Different from water and other molecular solvents, ILs encourage weak amphiphiles, such as alcohols, to self-assemble into a two-component microemulsion [3-4]. An insight into the amphiphilicity of ILs will open up many opportunities, including tailored liquid nanostructure and highly functional materials.

Our current study expands the scope of amphiphilic self-assembly. We utilise ILs to induce liquid nanostructure without the presence of a surfactant, such as the water-IL-oil system shown in Figure 1. Using small-angle X-ray scattering, we examine the liquid nanostructure of IL-containing mixtures at various compositions. Depending on the concentration, ILs can act as either ionic additives or self-assembly media. Our systems are simple yet novel. All components are liquids at room temperature, thermally stable, easy to handle, non-halogenated and have low-toxicity. Two model protic ionic liquids (PILs) were chosen: propylammonium nitrate (PAN) as an amphiphilic PIL, and ethanolammonium nitrate (EtAN) as a non-amphiphilic PIL. Using phase diagrams and X-ray scattering we demonstrate the ability of PILs to create nanostructure, starting from binary mixtures. We further illustrate a systematic change in nanostructure by introducing a third component, and we establish a new matrix of PIL-containing microemulsions with predictable structural behaviour.

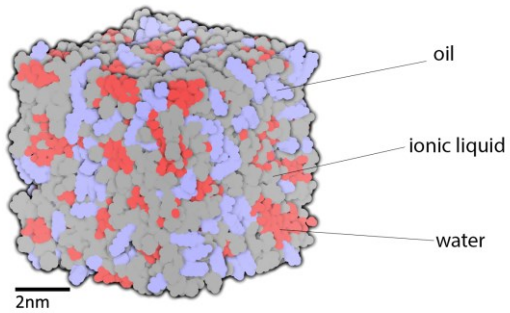

Figure 1 Ionic liquid replaces surfactant to induce miscibility betwwen water and oil, forming a surfactant-free microemulsion.

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