Investigating Solvation Properties of Ionic Liquids on Silica Nanoparticles Using Scattering Techniques

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Protic ionic liquids (PILs) are gaining increasing attention due to their controllable chemical structure, hydrogen-bonding capability, and potential for sustainable solvent design [1]. Mixing PILs with molecular solvents such as water has been shown to reduce viscosity and cost [2], but also introduces complex changes in physicochemical behaviour [3]. While solvation properties of neat ionic liquids are relatively well understood, less is known about how these properties evolve in mixed IL–water systems [4], particularly near solid–liquid interfaces. In this study, colloidal silica nanoparticles are used as model systems to probe solvation behaviour in mixtures of water and ethylammonium-based PILs with varying water content. Silica's well-defined negative surface charge and high stability provide an ideal platform for investigating interfacial interactions [5]. A concentration series ranging from neat water to neat PIL was prepared. Dynamic Light Scattering (DLS) and small-angle X-ray scattering (SAXS) were employed to investigate both the dynamic behaviour and structural aspects of the solvation layer.

The preliminary results indicate potential changes in solvation layer thickness and particle–solvent interactions as a function of PIL concentration. These trends may suggest structural rearrangements at the interface, differing from those in the bulk. The combination DLS and SAXS provides complementary insight into the dynamic and structural aspects of solvation, contributing to a better understanding of ion-specific effects in IL–water systems.

References

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Amani Alzahrani is a second-year PhD student at RMIT University under the supervision of Prof. Tamar Greaves, Prof. Gary Bryant, Dr. Saffron Bryant, and Dr. Hank Han. She has an undergraduate background in nanotechnology and physics and has previously studied the characterization of non-spherical nanoparticles using scattering techniques. Her current research focuses on investigating the solvation layer around silica nanoparticles in protic ionic liquid–water mixtures. She primarily uses SAXS and DLS to gain deeper insight into the structure and behaviour of solvation layers of nanoparticles in PIL-based solvents.