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Non-Aqueous Solvent Based on Protein- Polymer Surfactant Conjugates

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Non-aqueous solvents particularly those having low-volatility are of great interest for the bio-catalytic synthesis of utility chemicals and fuels. In this context, ionic liquids and deep eutectic solvents have been identified as green and environmental friendly solvents for various organic transformations. In spite of finding usage in variety of applications the ionic liquids have several limitations in terms of toxicity, preparation, high cost and most importantly their inability to disperse proteins with the structure of the later intact. Here we show novel solvent- like properties of a water-less bio-conjugate system (WL-BC) formed *via* electrostatic binding of anionic polymer surfactant on to the surface of positively charged globular protein. This highly viscous, low volatility material containing <1 wt. % water, above its solid-liquid transition temperature of ≈27 °C can be used to dissolve, and disperse variety of solutes of different sizes (ranging from few angstroms to microns) and surface chemistries. Using a combination of bright field optical microscopy and fluorescence spectroscopy we show that dry and powdered protease enzyme can be solubilized and dispersed at 30 °C in the WL-BC solvent. This solubilisation is accompanied by a decrease in the tryptophan emission from WL-BC possibly as a result of protease mediated change in environment around tryptophan residues on the bio-molecular solvent. Time-correlated single photon counting experiments for a relatively smaller dye molecule (Coumarin 153; C153) dispersed in the WL-BC shows a single lifetime of 5.4 ns which is different from the two lifetimes of 1.93 ns and 5.32 ns observed for native biomolecule in the aqueous solution. The lifetime data also shows that the C153 binds similarly irrespective of its sequence of addition in the steps related to the synthesis of the WL-BC. Interestingly, experiments performed by mixing of 1 μm polystyrene beads dry powder (diffusion coefficient approximately 3 orders of magnitude slower than C153 and protease) in WL-BC liquid shows complete dispersion of the former within 24 hrs, thus highlighting the widespread prospective utility of these materials as media and catalysts.