Structural and Spectroscopic Studies of Covalently Modified Proteins in Ionic Liquids: Hemoglobin and Cytochrome *c*. William T. Heller[1], Shelia N. Baker[2], Gary A. Baker[3]. [1]Center for Structural Molecular Biology, Oak Ridge National Laboratory, Oak Ridge, TN 37831; [2]Chemistry Division and [3]Bioscience Division, Los Alamos National Laboratory, Los Alamos, NM 87545.

Ionic liquids, salts that are molten at room temperature, are of great interest as solvents for a wide variety of chemical processes. These solvents, which can be designed to have specific physicochemical properties, are promising candidates for green, recyclable chemistry due to their negligible vapor pressures. While there are countless examples of chemical reactions performed efficiently in ionic liquids, examples of efficient biocatalysis within ionic liquids are less common. Moreover, protein structure, organization and dynamics have not been addressed within this class of solvent. This scenario stems largely from the fact that proteins generally have prohibitively low solubilities in ionic liquids. To increase protein solubility within ionic liquids, we covalently modified the surface of the hemoproteins hemoglobin and cytochrome *c* with polyethylene glycol (PEG) chains which act as phase transfer agents. We report recent studies using small-angle x-ray scattering (SAXS) and optical spectroscopy to characterize the states of the PEG-decorated hemoglobin (Hb-PEG) and cytochrome *c* (cyt *c*-PEG) within aqueous and ionic liquid solvent systems. Our results demonstrate that high protein loadings can be achieved in appropriately functionalized ionic liquids. Soret band CD studies suggest that the environment of the heme group of cyt *c*-PEG changes significantly when dissolved in an ionic liquid while the environment surrounding Hb-PEG remains relatively unperturbed. There are also significant structural differences. SAXS profiles show that while Hb-PEG is primarily monomeric in water, Hb appended with PEG chains self-assembles into large, well-defined aggregates in the ionic liquid.