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Repairable, nanostructured biomimetic hydrogels[1] M. FIRESTONE, LANL, S. BROMBOSZ, S. GRUBJESIC, ANL — Proteins facilitate many key cellular processes, including signal recognition and energy transduction. The ability to harness this evolutionarily-optimized functionality could lead to the development of protein-based systems useful for advancing alternative energy storage and conversion. The future of protein-based, however, requires the development of materials that will stabilize, order and control the activity of the proteins. Recently we have developed a synthetic approach for the preparation of a durable biomimetic chemical hydrogel that can be reversibly swollen in water. The matrix has proven ideal for the stable encapsulation of both water- and membrane-soluble proteins. The material is composed of an aqueous dispersion of a diacrylate end-derivatized PEO-PPO-PEO macromer, a saturated phospholipid and a zwitterionic co-surfactant that self-assembles into a nanostructured physical gel at room temperature as determined by X-ray scattering. The addition of a water soluble PEGDA co-monomer and photoinitator does not alter the self-assembled structure and UV irradiation serves to crosslink the acrylate end groups on the macromer with the PEGDA forming a network within the aqueous domains as determined by FT-IR. More recently we have begun to incorporate reversible crosslinks employing Diels-Alder chemistry, allowing for the extraction and replacement of inactive proteins. The ability to replenish the materials with active, non-denatured forms of protein is an important step in advancing these materials for use in nanostructured devices

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