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Charge Transfer Dynamics in Photosensitizer-Hydrogenase Systems

Solar energy is one of the most promising renewable energy sources in the world today. High costs of materials isolation and processing and relative inefficiencies of current solar technologies necessitate further research and progress in this field. It is imperative to develop cheap, clean, and efficient solar energy harvesting and storage technologies, which can potentially be achieved through the production of hydrogen gas. Researchers have been investigating the possibility of coupling a hydrogenase enzyme to a photosensitizer, most commonly photosystem I or II, in order to drive the synthesis of hydrogen gas. The advantage of using hydrogenases is they are inexpensive and easy to make. However, their catalytic sites become deactivated in the presence of oxygen or carbon monoxide, which poses a problem when coupled with hydrolysis. We are looking into coupling hydrogenases with different electron donors such as ruthenium complexes, chromophores, and chromoproteins, with the end goal of using protein capsids organized into thin films as an assembly framework. I will be investigating the charge transfer dynamics of these systems in order to identify potential candidates and arrangements for a photosensitizer-hydrogenase system.