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Bio-inspired Approaches to Solar Energy Conversion

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Natural photosynthesis is carried out by organized assemblies of photofunctional tetrapyrrole chromophores and catalysts within proteins that provide specifically tailored environments to optimize solar energy conversion. Artificial photosynthetic systems for practical solar fuels production must collect light energy, separate charge, and transport charge to catalytic sites where multi-electron redox processes will occur. The primary goal of our research in this field is to understand the fundamental principles needed to develop integrated artificial photosynthetic systems. These principles include how to promote and control: 1) energy capture, charge separation, and long-range directional energy and charge transport, 2) coupling of separated charges to multi-electron catalysts for fuel formation, and 3) supramolecular self-assembly for scalable, low-cost processing from the nanoscale to the macroscale. The central scientific challenge is to develop small, functional building blocks, having a minimum number of covalent linkages, which also have the appropriate molecular recognition properties to facilitate self-assembly of complete, *functional* artificial photosynthetic systems. This lecture will describe our use of ultrafast optical spectroscopy and time-resolved EPR spectroscopy to understand charge transport in self-assembled structures for artificial photosynthesis.