Photobiocatalytic Platforms for Solar Production of Fuels and Value-Added Chemicals

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Abstract
The idea of solar energy utilization in chemical synthesis through the combination of photocatalysis and biocatalysis provides an opportunity to make the green process greener. Recent progress indicates that photoinduced electron transfer using organic or inorganic photosensitizing materials can activate a wide spectrum of redox enzymes to catalyze fuel-forming reactions (e.g., H_2 evolution, CO_2 reduction) and synthetically useful reductions. This talk will provide a conceptual description of photobiocatalysis that couple enzymatic reduction reactions with photochemical water oxidation towards mimicking natural photosynthesis. Our research works in the light-driven, enzyme-based production of fuels and value-added chemicals will be presented according to the methods of cofactor regeneration and the hybridization of oxidoreductases and photosensitizing materials. For more efficient utilization of solar energy, we have recently developed Z-scheme-based biocatalytic photoelectrochemical cells (e.g., a tandem platform integrated with an enzyme-cascade system for sequential reduction of CO_2 to formate, formaldehyde, and methanol), involving dual illumination on both anode and cathode through mimicking the two-step photoexcitation scheme of natural photosystems. I will discuss future perspectives to take yet-to-be-expected next steps in the vibrant field of biocatalyzed artificial photosynthesis.

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