Catalytic Transformation of Photons into Chemical Bonds

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Producing solar fuels is recognized to be a candidate avenue for carbon-neutral energy futures. However, this process still suffers from an infancy stage of energy efficiency alongside overall selectivity toward higher-value fuels. This talk accounts for advances in sustainable chemistry using light-matter interactions to convert small molecules to more useful forms. For example, this talk introduces remarkable enhancements of the hydrogen generation via biomimetic water splitting under visible light excitation and care about how the chemical potential of plasmonic excitations is utilized to drive thermodynamically uphill carbon fixation. The chemical potential contributed by plasmon-induced charge carriers is found to be a function of the concentration of photon, offering a rich handle to promote the selectivity of carbon fixation toward energy-dense hydrocarbons. Mechanistic and kinetic models that govern the harvesting of the free energy of light for the reactions are presented in this talk. The findings represent a unique opportunity of light-matter interactions as sources of free energy for the synthesis of high-energy and complex molecules.