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Artificial photosynthesis to convert CO_2 into solar fuels: Can we do better than Mother Nature?

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Finding effective ways for conversion of CO_2 into hydrocarbons (as energy fuels or chemical feedstock) is highly desirable to achieve sustainable development. Artificial photocatalytic conversion of CO_2 to hydrocarbons such as methanol makes possible simultaneous solar energy harvesting and CO_2 reduction, two birds with one stone for the energy and environmental issues. In this talk, I will overview the current status in artificial photosynthesis and present our progress in green processing of earth-abundant and environment-friendly semiconductors to achieve the goal. In our attempt, modified graphene oxides (GOs) has been utilized to prove the concept and showed 4 times enhancement in activity over a commercial TiO_2 (P25). Further modification including copper nanoparticle addition to form hybrids to achieve 60 times enhancement in catalytic activity has been demonstrated. On the other hand, a SnS_2 with carbon addition yield quantum efficiency up to 0.7% to convert CO_2 into acetaldehyde, which is highly valuable in polymer industry. The conversion efficiency is comparable to that of photosynthesis in nature and sheds light for a brighter future. Detailed preparation, characterization, and performance of the catalysts will be presented. The role and interplay of the constituent components will also be discussed.

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Replacing $Pd(OAc)_2$ with supported palladium nanoparticles in C-H bond, C-O bond activation reaction

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Supported palladium nanoparticles were used as an efficient catalyst for C-H bond, C-O bond activation reaction for the synthesis of aromatic ketones, amides and quinones. The catalyst can be reused for five cycles without significantly losing activity. The XPS analysis of the catalyst before and after reaction suggested that the reaction might be performed via a catalytic cycle that began with Pd^0. The hot filtration test strongly suggests that the present reaction would proceed via heterogeneous manner.

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