Development of Solar Chemical Factory Platform for Production of Solar Fuel/Chemicals

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Abstract

The natural photosynthetic process has fascinated chemists for long due to its high specificity in solar energy conversion to sugar. However, given the structural and functional complexity, it is a challenge to mimic this natural process. Nonetheless, efforts to develop efficient photosynthesis mimetic systems have been going on since 1970s. In recent years, these efforts have intensified due to increasing emphasis on the development of carbon-free or carbon-neutral systems/technologies for production of solar fuel/chemicals. Utilizing the natural photosynthesis as blueprint, a number of covalent, and non-covalent donor-acceptor conjugate dyes have been studied as systems for CO₂ fixation. Although capable of efficient photoinduced intra- and intermolecular electron transfer (ET), they suffer from poor conversion efficiency and lack photostability. For enhanced efficiency and photostability, a variety of photocatalytic materials, such as inorganic frameworks and metal complexes have been developed and evaluated. However, their direct utilization remains limited due to one or more reasons, which include, low NAD(P)H regeneration, poor selectivity, limited photostability and inability to work in visible light. This has led to emergence of the coupling of a suitable visible light active photocatalyst to an enzyme as an exciting avenue of research in this area.

In this regard, we developed the photocatalyst/enzyme integrated solar chemical factory platform system that exemplified solar energy in synthesis of solar fuel & solar chemicals. Generating NAD(P)H in non-enzymatic light-driven process and coupling it to the enzymatic dark reaction catalysis for the tailor-maid solar chemical synthesis via photobiocatalysis. The present work demonstrates successfully a new and potentially promising solar solar chemical factory platform system for the ultimate goal of utilization of solar energy in fuel & fine chemical synthesis.

Biography

Dr. Jin-Ook Baeg received a Ph.D. degree in chemistry from University of Ottawa (Canada) in 1995, and postdoctoral fellow at Harvard University (USA) from 1995 to 1997. His main research interests mainly focused on artificial photosynthesis for solar fuel/solar chemical production and photocatalysis for solar hydrogen production. He now serves as a head of CO2 Energy Vector Research Center (KRICT), Adjunct Professor of Korea University and vice President of Korean Society of Photoscience (KSP).