Artificial Photosynthesis - Development Challenges

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Abstract

The present approaches pursued in artificial synthesis are introduced, encompassing water photolysis, photoelectrocatalytic carbon dioxide reduction and (photo)electrochemical ammonia synthesis. Photoelectrochemical water splitting with monolithic devices has progressed rather far with record efficiencies beyond 18% solar-to-hydrogen generation[1-3]. These systems and their underlying approaches will be reviewed and the remaining challenges are addressed including possibilities in space applications[4]. Challenges relate to the lifetime, efficiency and costs product. Hence roads to stability, increased efficiency and the use of earth abundant materials for terrestrial use are described and assessed.

Present efforts in carbon dioxide reduction are reviewed and the issue of developing highly reaction-selective electrocatalysts and combining them with photo-absorbers is emphasized. In electrolyte ammonia synthesis, very recent concepts are introduced, deduced from the surface analytical understanding of the Haber-Bosch process[5].

The interrelation of empirical work and detailed mechanistic understanding that includes surface science will be addressed.

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