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Biography

Hongxian Han received PhD degree in Chemistry from the University of New South Wales(UNSW), Sydney, Australia in 2003, and worked as postdoc fellow and research scientist in Lawrence Berkeley National Laboratory (LBNL) from 2003-2009. He is currently a professor in Dalian Institute of Chemical Physics and Dalian National Laboratory for Clean Energy, Chinese Academy of Sciences, China. He has published more than 60 papers in peer reviewed journals, such as Nature Commun., J. Am. Chem. Soc., Angew. Chem. Int. Ed., Energy Environ. Sci., Chem. Rev. etc. His research interests cover mainly artificial photosynthesis for solar fuel production, heterogeneous electron transfer and application of advanced spectroscopy for better understanding.

Separation and Transfer of Photogenerated Charges in Semiconductor-based Photocatalysts and Photoanodes for Efficient Water Splitting

The key processes of photocatalytic water splitting includes light absorption, charge separation and surface redox reactions. Among them, efficient charge separation and transfer plays essential role in determinging the overall energy conversion efficiency. It is necessary to develop novel strategies for efficient charge separation and transfer.

The followig recent progress in our laboratory toward efficient separation and transfer of photogenerated charges in semiconductor-based photocatalysts and photoanodes will be presented. 1) Efficient separation and transfer of photogenerated charges in TiO_2 photoanode thin films by tailor-control of anatase/rutile TiO_2 phase junction. 2) Efficient charge separation between the non-equivalent {010} and {110} facets of $BiVO_4$ for water oxidation[2], and the importance of dual redox cocatalysts on charge separation for overall water splitting by cubic $NaTaO_3$ with the equivalent facets. 3) Two electron transfer process from CdS semiconductor to CoPy molecular hydrogen evolution catalyst under strong alkaline condition.

In conclusion, the phase junction approach has been demonstrated to be also effective in PEC system for charge separation and transfer. Facet charge separation may occur on the semiconductors with non-equivalent facets, and spatial loading of dual redox cocatalysts on the different facets led to high photocatalytic activity. As for the semiconductors with equivalent facets, efficient charge separation can still be achieved by loading dual redox cocatalysts. And the proposal of two electron transfer mechanism may give a chance to further examine multi-electron transfer processes, which is a one of the black box in the research of solar energy conversion.