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Oomman K Varghese

University of Houston, USA

Advanced materials for solar photoelectrochemical fuel generation

Fuel generation using solar energy has been widely investigated as a potential pathway for sustainable development in the energy sector. Various technologies, normal and hybrid, have emerged in recent years to generate fuels from sources such as water and carbon dioxide utilizing the ultraviolet/visible or thermal (or both) components of the solar spectrum. Solar photoelectrochemical fuel generation is one such technology that utilizes the photocatalytic properties of semiconducting materials to convert energy in the ultraviolet/visible part of the solar spectrum to fuels. The process does not require elevated temperature or pressure conditions. The sunlight to fuel conversion efficiency is, however, not yet high enough to apply the technology on a commercial scale. The primary limitation is in the inability of the photocatalysts to absorb visible light photons or transport the photo-generated charge carriers to the surface for redox reactions. Wide band gap photocatalysts such as titanium dioxide transport charge carriers relatively better than narrow band gap semiconductors such as iron oxide; however, wide band gap materials utilize only the ultraviolet photons. We recently introduced a strategy that consists of joining a wide band gap and a narrow band gap nanoarchitecture to form a heterostructure photoelectrode. Such electrodes exhibited promising characteristics for broad-spectrum light utilization. These results along with the current state of the technology will be discussed in this presentation.

Biography

Oomman K Varghese received PhD in Physics from Indian Institute of Technology Delhi (IITD), India in 2001. He is currently an Associate Professor in the Physics Department, University of Houston. He has published over 100 peer-reviewed articles, one book, a book chapter, and two patents. His publications have received over 31000 citations (Google Scholar h-index is 67). In 2011, Thomson Reuters ranked him 9th among 'World's Top 100 Materials Scientists' in the past decade. In 2014, 2015 and 2016 he received the title 'Highly Cited Researcher' and had a name listed in Thomson Reuters' World's Most Influential Scientific Minds.

okvarghese@uh.edu

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