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Molecular Engineering of Colorants for Solar Cell Applications

Mohammad K. Nazeeruddin
Institute of Chemical Science and Engineering

Dr. Md. K. Nazeeruddin received his Ph. D in inorganic chemistry from Osmania University, Hyderabad, India in 1986. He joined as a Lecturer in Deccan College of Engineering and Technology, Osmania University, and subsequently, moved to Central Salt and Marine Chemicals Research Institute, Bhavnagar, as a Research Associate. He was awarded the Government of India's fellowship in 1987 for study abroad. After one year postdoctoral stay with Prof. Graetzel at Swiss federal institute of technology Lausanne (E P F L), he joined the same institute as a Senior Scientist. His current research focuses on dye-sensitized solar cells, hydrogen production, light-emitting diodes and Chemical sensors. He has published more than 180 peer-reviewed papers, eight book chapters, and inventor of 19 patents. The high impact of his work has been recognized with invitations to speak at over 35 international conferences, including the MRS Fall Meeting (USA, 2006), and has been nominated to the OLLA International Scientific Advisory Board. He appeared in the ISI listing of most cited chemists, and his total numbers of citations are around 8000, with "h index of 42". He is directing, and managing several industrial, national, and European Union projects on hydrogen energy, photovoltaics (DSC), and organic light emitting diodes. He was awarded EPFL Excellence prize in 1998, 2006 and 2008, Brazilian FAPESP Fellowship in 1999, Japanese Government Science & Technology Agency Fellowship in 1998, Government of India National Fellowship in 1987-1988. Recently Korea University in Jochiwon has appointed him as World Class University (WCU) professor for the period of March 1, 2009 - December 31, 2012.

ABSTRACT

Nanocrystalline TiO_2 based Dye-Sensitized Solar Cells (DSSC) are potentially low in cost compared to the conventional silicon solar cells. The DSSC consists of a working electrode, which is a sensitizer derivatized mesoporous TiO_2 film, and a counter electrode, sandwiched with an iodide/triiodide (I-/I3-) redox electrolyte. The immobilized sensitizer absorbs a photon to produce an excited state, which transfers efficiently its electron into the TiO_2 conduction band. The oxidized dye is subsequently reduced by electron donation from the iodide/triiodide redox system. The injected electron flows through the semiconductor network to arrive at the back contact and then through the external load to the counter electrode. At the counter electrode, reduction of triiodide in turn regenerates iodide, which completes the circuit. In these cells the colorant is one of the key components for high power conversion efficiency. In my talk I will discuss the various design strategies of colorants consisting of different ligands with specific functionality and their power conversion efficiencies.