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Biography

Md Akhtaruzzaman is an Assoc Professor at the Solar Energy Research Institute of The National University of Malaysia (Universiti Kebangsaan Malaysia), where he is leading the organic-inorganic hybrid solar cells unit at solar photovoltaics group. After received his BSc in 1996 and MSc in 1998 in Applied Chemistry and Chemical Engineering from The University of Dhaka, he has been awarded the Japanese Government's Monbukagakusho scholarship and joined at the Institute for Molecular Science in Okazaki, Japan where he obtained his PhD in March 2003. Thereafter, he worked in Japan for 12 years (Tokyo Institute of Technology, Fujifilm Fine Chemicals Co. Ltd., and Tohoku University), King Saud University in Saudi Arabia and University of Malaya (UM) in Malaysia. He has published over 70 papers, reviews in peer- reviewed journals, and patents, and book chapters.

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MOLECULAR ENGINEERING AND PROSPECTS OF ORGANIC DYES FOR DYE-SENSITIZED SOLAR CELLS (DSSC)

The dye-sensitized solar cells (DSCs) have gained popularity due to their ease of fabrication, light weight, and capability for being processed in ambient conditions. Although significant research has focused on the improvement of DSSC performance, chemists, materials scientists and engineers still face many challenges for practical realization of DSSCs in real world application. Typically, a DSSC consists of a photoanode composed of a dye monolayer adsorbed on mesoporous semiconductor oxide coated on a transparent conducting substrate, an electrolyte and a counter electrode. The dye plays a crucial role in designing efficient DSSCs as it should capture as much incident light as possible by optimization of the absorption strength (molar extinction coefficient) and overlap of the absorption with the solar spectrum (i.e., the absorption spectral width). Simultaneously, the dye should inject the photo generated electron into the semiconductor oxide. Until now, the dyes (organic/metal complexes) in use have strong absorption in the UV-visible region with power conversion efficiency (PCE) up to 13%. However, there have been a few individual dyes identified that have panchromatic light harvesting ability in near-infrared (NIR) region with the PCE <7%. So, the alternative approach to capture the light over a wide range of absorption spectra by co-sensitization using multiple dyes has been studied and verified with increased light harvesting properties. Co-sensitization of multiple organic dyes which contain maximum absorption in sensitive smaller parts of the visible region of 300-850nm is probable. The high molar extinction coefficients, easy structural modification and facile synthesis process of metal free organic sensitizers make them ideal candidates for designing co-sensitized DSSCs. Different type of sensitizers and co-adsorbents have been designed, synthesized and analyzed so far. This phenomenon will successfully enhance the efficiency of a DSSC and create new pathways to obtain custom molecular engineered DSSC for real life applications.

Note: