可視色素と近赤外色素の色素カクテルを利用した透明色素増感太陽電池の作成と特性評価

Fabrication and Characterization of Transparent Dye Sensitized Solar Cells utilizing Dye-Cocktail of Visible and NIR Dyes

Kyushu Institute of Technology, [O]Pritha Roy, Ajendra Kumar Vats, Linjun Tang, Shyam S. Pandey

E-mail: prithajnu@gmail.com

Dye-sensitized solar cells (DSSCs) have been widely investigated as one of the next-generation solar cells because of their easy fabrication and low of cost along with the good power conversion efficiency (PCE) especially under low light intensities. By tuning the color of sensitizers and thickness of mesoporous TiO_2, DSSC can be made transparent, which is highly suitable for the energy harvesting windows. To realize transparent DSSCs, one of the plausible solutions is to utilize sensitizers bypassing the photons between the 500 nm-600 nm, where human eye is highly sensitive [1]. Therefore, dyes absorbing in lower (<500 nm) or near infrared (NIR) wavelength region could be an amicable approach towards transparent/semi-transparent DSSCs. To compensate the loss of photon harvesting in the high eye-sensitivity region, utilization of the dye-cocktails of two different dyes with absorption in <500 nm (D-131) and >600 nm (SQ-140), respectively have been attempted in this present work.

Transparent TiO_2 paste (T/SP, Solaronix) and very thin layer of Pt coated FTO glass have been used for making working photoanodes and counter electrodes, respectively. Commercially available dye D-131 and green colored NIR dye (SQ-140) synthesized in our laboratory were used as sensitizers. Dye sensitization were done by dye cocktail of these dyes with different ratios followed by the fabrication and characterization of transparent DSSCs thus fabricated.

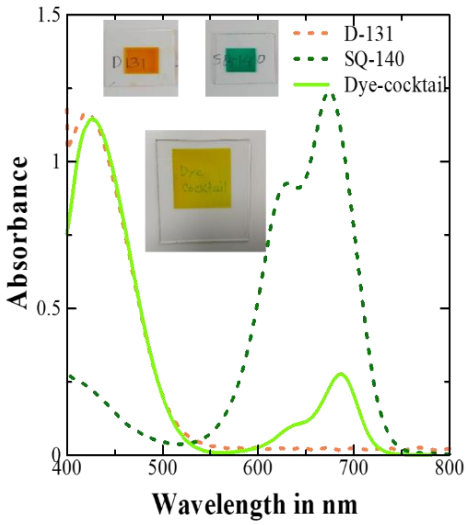

Fig. 1 Solid-state absorption spectra and photographs (inset) of the photoanodes fabricated by respective dyes and their dye-cocktail (9:1)

A perusal of the solid-state absorption spectra as shown in the Fig.1, clearly reveals that dyes D-131 and SQ-140 exhibit absorption maxima at 430nm and 680nm, respectively, which are well beyond the high sensitivity region of the photopic vision and responsible for the transparency of the DSSCs based on these dyes. Although, dye aggregation of the SQ-140 exhibit a small light absorption between 550 nm-600 nm but utilization of small fraction of this dye in the dye-cocktail (9:1) solves this issue making the DSSC relatively more transparent. Transparent DSSCs fabricated using the dye-cocktail of D-131 and SQ-140 (9:1) exhibited a PCE 4.4 % with very high average visible transparency (AVT) of about 80 %. Details about the ratio of individual dye in dye cocktail and characteristics of DSSCs in terms of PCE and AVT will be discussed during my presentation.

References:

1. K. Zhang, C.J. Qin, X. Yang, A. Islam, S. F. Zhang, H. Chen, L. Han, Advanced Energy Materials, 2014, 4, 1301966.