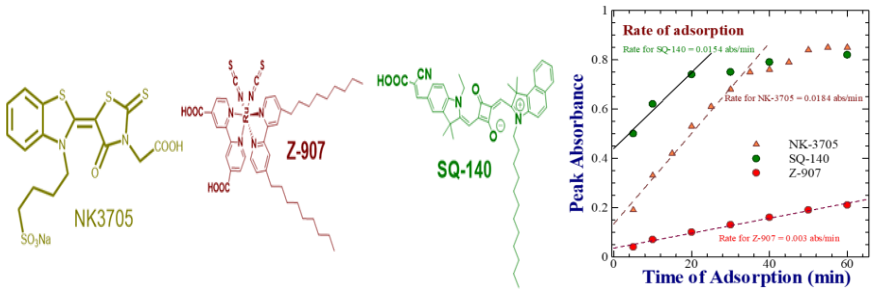
Investigation of Adsorption Behavior of Multiple Dyes on TiO_2 for Bifacial Dye-Sensitized Solar Cells

Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology, 2-4, Hibikino, Wakamatsu, Kitakyushu, Japan) ○ Suraya Shaban, Linjun Tang, and Shyam S. Pandey,[1]

Keywords: NIR dye, dye sensitized solar cells, dye-bilayer, adsorption behavior, bifacial solar cells

Bifacial dye-sensitized solar cells (BF-DSSCs) with the capability of photon harvesting from both of the front and rear sides utilizing multiple dye-sensitizers with varying optical absorption window for panchromatic photon harvesting are advantageous for enhancing the photoconversion efficiency of such solar cells. Use of multiple sensitizers in DSSCs, quite often lead to unwanted inter-dye interactions leading to the hampered photon harvesting. To circumvent this issue, implementation of dye-bilayers has been proved to be beneficial leading to the synergistic photon harvesting from both of the dyes by suppressing the inter-dye interactions [1]. In this work, it was demonstarted that use two dyes with differential rate of dye adsorption and their binding strength on TiO_2 surface leads to the formation of dye double layer from the dye cocktail of the two dyes. In this present work, sensitizing dyes such as Z907, NK-3705 and SQ-140 with chemical structure as shown in the Fig. 1 have been used as sensitizers for BF-DSSCs aiming towards widening of the optical absorption window. Dye adsorbed TiO_2 was used as photoanode to make BF-DSSCs coupled with the iodine-based redox electrolyte and ultra-thin Pt-coated FTO as transparent counter electrode. Adsorption behavior of these dyes along with their binding strength on the mesoporous TiO_2 was systematically investigated by electronic absorption spectroscopy. It can be clearly seen from the Fig. 1 that dyes NK-3705 and SQ-140 exhibits fairly high rate of dye adsorption as compared to that of their Z-907 dye counterpart. The ratio of dyes and adsorption time were discovered to play a significant role in influencing the kinetics of bilayer formation from mixed dye present in the dye cocktail. Implication of such differential dye adsorption behavior on the device performances of BF-DSSCs after the front and rear illuminations, bifaciality factor, and cumulative PCE, will be discussed in my presentaion.



1) Y. Ogomi, S. S. Pandey, S. Kimura, and S. Hayase, Thin Solid Films 519 (3), 1087-1092 (2010)