Strategy for Improved Photovoltaic Performance in Thin Film Electrodes and New Device Fabrications

Jun-Hyeok Park[1], Byung-Man Kim[2], Hyun-Gyu Han[1] and Tae-Hyuk Kwon[1,2]

[1] Department of Chemistry, Ulsan National Institute of Science and Technology, Ulsan, 689-798, Republic of Korea [2] School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology, Ulsan, 689-798, Republic of Korea

Email : kwon90@unist.ac.kr

To date, most of research on dye-sensitized solar cells (DSCs) have focused on high performance on thick photoelectrode, however, this is far away from economic process and flexible-type DSC that require thin film electrode because of their delamination problem in thick film. In addition, there are little research on the control of dye distribution and capacity of mesoporous TiO2 film, as well as fast adsorption.

In this presentation, for a commercialization of DSCs, I will first present to design strategy of sensitizer for high photo conversion efficiency (PCE) with a thin active layer. By investigating the charge transfer kinetics and dye adsorption processes, the alkyl chain length plays critical role on the recombination rate between the injected photoelectrons and the oxidized redox mediators as well as the dye surface coverage.[1] Furthermore, the planarity of organic sensitizer is one of the most influential factor in determining molar absorptivity and charge transfer.

Next, novel, commercially viable deposition techniques for the preparation of TiO2 electrodes are introduced. The first methods, namely pre-dye-coating and codeposition ultrasonic spraying, eliminate the conventional need for time-consuming processes such as dye soaking and high-temperature sintering process. [2] Second, I will present a simple, sustainable, and inexpensive dyeing method, gas bubbling soaking (GBS), which not only helps the dye molecules to distribute evenly within the porous TiO_2 film, but also significantly shortens the device fabrication time.[3] GBS produces an even vertical dispersion throughout the porous TiO2 film, as clearly illustrated by time-of-flight secondary ion mass spectrometry depth profiles and Plasmon sensor.

References:

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