Sri Lanka-Japan Collaborative Research on Dye-sensitized Solar Cells

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Dye-sensitized Solar Cells (DSCs) are gaining a very high reputation as promising and cheap alternatives to silicon-based solar cells for conversion of solar energy into electricity. These systems do not involve handling of hazardous materials and the energy requirement for the fabrication process is relatively low compared with those of silicon solar cell. We have been actively involved in constructing different types of DSCs and assembling them into solar cell modules. Intensive studies have been made on understanding the mechanisms of operation of these devices. In our past research work at Shizuoka University, Japan, University of Peradeniya and IFS, Sri Lanka, our primary attention has been to find ways of improving the photovoltaic performance of DSCs and dye-sensitized solid-state cells Solar Cells (DSSCs).

Grätzel-type DSCs based on interconnected nanoparticle matrix of titanium dioxide, TiO_2 are well known. However, the liquid electrolyte in a Grätzel cell presents a number of technical problems such as solvent leakage, evaporation loss, photodegradation of components in the electrolyte, etc. For the first time, we were able to show that the problems of the electrolyte were completely resolved if a p-type semiconducting material was used as the hole-collector. We were successful in identifying suitable hole-collectors and developing methods for their deposition. As such, we were the pioneers in introducing All-Solid-State-Dye-sensitized Solar Cells using p-type semiconductors such as CuI, CuSCN and so on[1]. We continued this work at Shizuoka University, Japan, and were able to develop DSSCs which yielded the highest recorded efficiency and to improve their long-term stability.

We have also shown that much information and insight into the mechanism of operation and strategies for improving the photovoltaic performance of DSCs could be gained by looking into other composite semiconductor particulate systems. An important observation we made was that the photovoltaic performance of SnO_2 is dramatically enhanced when thin layers of certain insulators are coated on the SnO_2 crystallite surface. Promising results were obtained when SnO_2 was coated with thin films of ZnO, MgO or $CaCO_3$. The work has generated over 60 high-indexed publications during the past 20 years.

References:

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