Sri Lanka-Taiwan Bilateral Symposium on Energy, Environment and Nanotechnology

台灣－斯里蘭卡連結計畫

Taiwan-Sri Lanka Connection Project

June 1st ~ 3rd, 2018

June 1st @Applied Science & Technology Building
June 2nd ~ 3rd @Huisun Forest Station
National Chung Hsing University, Taiwan

MINISTRY OF EDUCATION 教育部

University of Peradeniya

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OFFICE OF INTERNATIONAL AFFAIRS AT NCHU

RCSEN 永續能源與奈米科技研究中心 NCHU

Session II (16:05-16:30, Sat)

Presentation title:
Use of Nanotechnology for Improved Performance of Dye-sensitized Solar Cells

Speaker's name and affiliation:
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Brief biography of Speaker:

Prof. G.R. A. Kumara received B.Sc. (1993) from University of Peradeniya, Sri Lanka; M. Phil. (1997) from University of Sri Jayewardenepura, Sri Lanka; and Ph.D. (2001) from Shizuoka University, Japan. He has served in many institutions in Japan in various capacities, such as a Visiting Professor in Shizuoka University and Toyota Technological University, and as a Senior Scientist in SPD Laboratory. He has been awarded MONBUSHO Japanese Government Fellowship (1999), JST Japanese Government Fellowship (2004) and JSPS Japanese Government Fellowship (2004). He is a recipient of many recognized awards in Sri Lanka, namely Young Scientist Award (NSF) President's Research Awards, NRC Merit Award and NSF SUSRED Awards. At present, Prof. Kumara is a Research Professor at National Institute of Fundamental Studies, Sri Lanka.

Abstract:

Dye-sensitized solar cells (DSCs) continue to receive attention despite their instability and relatively low efficiency. However, new concepts being emerged could lead to major breakthroughs. In this regard, primary attention was given to find ways of improving the photovoltaic performance of dye-sensitized photoeletrochemical cells (DSCs) and dye-sensitized solid-state cells (DSSCs), and to examine different innovative versions of DSCs together with their mechanisms of operation. Technical problems associated with the liquid electrolyte of the DSC, based on interconnected nanoparticle matrix of TiO_2 could be resolved if a p-type semiconducting material, such as CuI and CuSCN, is used as the hole-collector. This methodology was continued to develop the DSSCs to yield the highest recorded efficiency and to improve their long-term stability. The DSSCs usually give lower efficiencies than DSCs. When CuI is deposited from an acetonitrile solution, crystallites formed are larger than the pore size of the TiO_2 film, and thus, filling of the pores is difficult. A solution to this problem would be the incorporation of a crystal growth inhibitor to CuI. Much information and insight into the mechanism of operation and strategies for improving the photovoltaic performance of DSCs could be gained by investigating other composite semiconductor particulate systems. An important observation 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. In our past research work, we were engaged in conversion of raw graphitic minerals into value-added products to be used as counter electrodes in dye-sensitized solar cells. In another related work, the utility coconut shells to produce highly porous and highly conducting activated charcoal for counter electrodes of solar cells were established. The cost factor associated with the construction of counter electrodes in DSCs and DSSCs can be addressed by developing coconut charcoal based counter-electrodes of performance almost equivalent to that of platinum.