Abstract No: 357 ***Natural Sciences***

COBALT BASED REDOX MEDIATORS FOR ZnO BASED DYE-SENSITIZED SOLAR CELLS

B.K.G.D.M. Dhanapala[1], O.A. Ileperuma[1]*, C.S.K. Ranasinghe[1, 2] and G.R.A. Kumara[1]

[1] Department of Chemistry, Faculty of Science, University of Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
**oliveri@pdn.ac.lk*

Zinc oxide (ZnO) has an equal band gap (~3.2 eV) but higher electron mobility (205–300 $cm^2\ V^{-1}\ s^{-1}$ for bulk ZnO) compared to TiO_2 (0.1–4 $cm^2\ V^{-1}\ s^{-1}$ for TiO_2) and is expected to give higher conversion efficiencies than TiO_2 based dye-sensitized solar cells (DSCs). The electrolyte in the DSCs plays a major role in the device performance. Cobalt complexes are interesting and feasible alternatives to conventional I^-/I_3^-, due to their higher open circuit voltages, non corrosiveness towards metals and minimal light absorption. However, cobalt redox couples yields poor performance, possibly due to high levels of recombination at the interfaces of conducting glass/electrolyte and semiconductor/electrolyte. In this work two cobalt complexes, $[Co(phen)_3]^{3+/2+}$ and $[Co(Me2bpy)_3]^{3+/2+}$ were investigated and commercially available I^-/I_3^- electrolyte was also used for comparison purposes. Also to reduce recombination at the conducting glass/electrolyte interface the ZnO dense layer was deposited on the conducting glass prior to the ZnO porous layer deposition to have a hierarchical ZnO structure and D358 dye was used as the sensitizer. The $[Co(phen)_3]^{3+/2+}$ was synthesized using orthophenanthroline and $CoCl_2.6H_2O$, and $[Co(Me_2bpy)_3]^{3+/2+}$ was synthesized using 2,2´-dimethyl-4,4´-bipyridine and $CoCl_2.6H_2O$. Three main types of cells were investigated by employing these three electrolytes. According to the I-V data, out of the two cobalt complexes, highest photovoltaic performances were obtained for the $[Co(Me_2bpy)_3]^{3+/2+}$ redox couple. Also the hierarchical ZnO structure has shown higher conversion efficiencies due to better electron transport in nanoporous ZnO layer to the conducting glass and lower recombination effects at the FTO/Electrolyte interface. The photovoltaic performance of $[Co(phen)_3]^{3+/2+}$ complexes compared to the $[Co(Me_2bpy)_3]^{3+/2+}$ complexes, is limited by solubility factor. Lower concentrations of the $[Co(phen)_3]^{3+/2+}$ redox couple in acetonitrile, were used compared to the $[Co(Me_2bpy)_3]^{3+/2+}$ complexes. Therefore, mass transport limitations are likely to have a larger impact on the I-V characteristics of DSCs with the $[Co(phen)_3]^{3+/2+}$ complexes. The cell with $[Co(Me_2bpy)_3]^{3+/2+}$ electrolyte shows a maximum power conversion efficiency of 3.62% while the corresponding cell with the I^-/I_3^- electrolyte shows an efficiency of 4.34% under similar conditions. The SEM micrographs confirm the densely packed ZnO structure and porous ZnO structure used in this work. Also corresponding XRD patterns confirms ZnO in both cases (JCPDS card No. 36 - 1451) while showing different trends in the respective planes. This study clearly shows the possibility of using cobalt based electrolytes in ZnO based DSCs.