Section 2

Executive Summary of the Project

Seeking a cost efficient alternative to the present day solar cells has received great attention in the last two decades and the solar cells made from organic materials received significant attention.

This project focuses nanostructured polymer based solar cells comprising fullerene electron acceptors. The titanium dioxide incorporated polymer solar cells were also added as one of the major component of this study as TiO_2 could offer several merits. Solar cells were made with a visible light responsive TiO_2 (VLR TiO_2) was also studied in this respect. One of the objectives of this study is that modifying the interfaces within the active layer as well as top electrode in view of enhancing the performance. To acquire better insight in this interface modification, dye sensitised solar cells were made employing both natural and synthesized sensitisers.

The power conversion efficiency (PCE) of polymer / fullerene solar cells having with or without TiO_2, both having PEDOT: PSS slightly influenced by the temperature and illumination intensity. However the cells with TiO_2 removes the need for PEDOT: PSS which tends to degrade the cell while causing significant increase in the PCE within a 30 ^{0}C temperature increase speculated to arise from the positive temperature dependence of open-circuit voltage that may be due to a "kink" in the current-voltage characteristics near open-circuit voltage.

In hybrid TiO_2/poly(3-Hexyl thiophene) (P3HT) solar cells the dependence of polymer uptake when dipping the electrode in the polymer and the role of poly(styrenesulfanate)-doped poly(3,4-ethylenedioxythiophene) (PEDOT:PSS) buffer layer were studied to enhance the performance. Dichlorobenzene was found to be the best dipping solvent with the optimized dipping parameters of concentration, temperature and the time as 1 mg/ml, 120 ^{0}C and 2 hr, respectively. In the study with the PEDOT:PSS layer the optimum power conversion efficiency (PCE) was observed with the 50 nm thick PEDOT:PSS layer.

Regarding to the application of TiO_2 in dye sensitized solar cells (DSSC), a modified Visible Light Responsive (VLR) TiO_2 has been introduced and found to be promising n-type semiconductor for the DSSC due to the improved optical absorption, dye adsorption and charge transport probably attributed to the high anatase content. In addition to this, both regular and VLR TiO_2 were incorporated with the grape fruit dye and a Ru based synthesized exhibited promising performance which is comparable to solar cells employing commercial dye.