FABRICATION AND CHARACTERIZATION OF SOME POLYMER AND PIGMENT-BASED DEVICES FOR SOLAR CELL AND ELECTROCHROMIC APPLICATIONS

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The anthocyanin pigment has a conjugated system and shows some properties characteristic to conjugated polymers and molecules. It has already been used as a photon harvesting material in dye-sensitized solar cells. In this study, the anthocyanin pigment was extracted from several plant materials using appropriate solvents such as methanol and acetone. The pigment was extracted mainly from seeds and roots of the plants and was used in the fabrication of dye-sensitized solar cell (DSC) device structures. Relatively better performances were shown by the pigments extracted from Maha-Bowitiya (*Melastoma malabathricum*) (BVT) and Hingurala (Dioscorea Purpurea) (POT). In order to study the potential of using these pigments in DSC's, they were characterized using UV-Visible absorption spectra, cyclic voltammetry, FTIR and Mott-Schottky plots. The TiO_2-based DSC devices were fabricated using liquid and quasi-solid electrolytes that contained I^-/I_3^- redox couple. Solid state devices were fabricated using CuI as the hole conducting material. The current-voltage characteristics of the fabricated devices were studied under dark and illuminated (1000 Wm^{-2}) conditions. The maximum photo-current of 3.5 mA cm^{-2} and the V_{OC} of about 500 mV was observed for the quasi-solid state DSC devices (of the type, FTO/TiO_2/pigment/gel-electrolyte/Pt) fabricated using the BVT pigment The efficiency of the DSC device was about 0.9 %.

The Natural pigment extracted from BVT seeds shows electrochromic (EC) properties by anchoring onto TiO_2 films on optically transparent conducting glass (FTO) plates. The device of the type, FTO/TiO_2/pigment/gel-electrolyte/FTO showed blue and white

switching states upon application of a voltage of reversible polarity in the range of 2.5– 4.5 V. The observed maximum transmittance variation (ΔT %) between two switching states was about 27 % and the best switching time was about 6 s which are both comparable with those of similar devices made with more elaborate device structures using artificial conjugated polymers.

Bulk-heterojunction (BH) organic polymer solar cell device structures of the type ITO/blend/LiF/Al were fabricated using fullerenes and MEH-PPV as the blend materials. The V_{OC}, J_{SC} and efficiency of about 590 mV, 2.21 mA cm^{-2} and 0.92 % were observed respectively for the fullerene/MEH-PPV blended devices. The potentials of using natural pigments along with fullerenes in the fabrication of BH solar cell devices were studied. The pigment extracted from Bixa *orellana L* (MTH) seeds which contains carotenes, shows some ability to be used as an electron donor in the fabrication of BH devices along with electron acceptor fullerenes. The SC devices fabricated using the pigment extracted from MTH seeds shows I_{SC}, V_{OC} and efficiency values of about 0.43 mA cm^{-2}, 450 mV and 0.07 % respectively.