PREPARATION AND CHARACTERISATION OF POLYANILINE / TITANIUM DIOXIDE HETEROJUNCTIONS FOR POSSIBLE USE IN SOLAR CELLS

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ABSTRACT

Polymer based photovoltaic cells are extensively studied since they offer a low-cost approach to the production of photovoltaic cells. One of the concepts of polymer-based photovoltaic cells is based on interpenetrating donor-acceptor heterojunctions such as polymer/C_{60}, polymer/TiO_2 nanocomposites that combine the functions of light absorption and carrier transport.

In this work, two devices of polyaniline/TiO_2 nanocomposites were prepared and studied for their possible use in photovoltaic devices. The first device, a layered device of PANI/ TiO_2, was prepared by sintering a thin layer of TiO_2 on a conducting glass and then depositing a thin layer of polyaniline on it by electrochemical polymerization. The second device, a blended device of PANI/TiO_2 was prepared using a mixture of TiO_2 colloid and polyaniline powder in different methods. The devices are characterized by absorption spectroscopy, X-ray diffraction, Mott Schottcky plots and I-V characteristic curves.

I-V characteristic curve of the PANI/TiO_2 layered device shows non linear diode type behaviouor with a significant rectification property but does not show any photo voltaic effect. Average particle size of the TiO_2 layer of this device (estimated using X ray diffraction graphs) is about 30 nm is slightly greater than the exciton diffusion length of these materials (polyaniline and TiO_2 - 20 nm). Therefore, recombination effects hindering photovoltaic action could be significant in these devices. The results of the Mott Schottckey plots show that the conduction band of the TiO_2 lies 0.6 eV below the conduction band of the polyaniline which supports the suggested model for the this device. The band gaps of TiO_2 and polyaniline were

measured using absorption spectra and the corresponding wavelengths matches with the wavelengths of the solar spectrum.

The blended devices show slight rectification but no photovoltaic effect and further improvement is needed to form high quality films.

Further work should be carried out in order to reduce the nanoparticle sizes down to about 10 nm to reduce recombination and to enhance photovoltaic action.