COMPOSITE SOLAR CELLS

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Plastic Solar Cells [1] provide the possibility of easy and cheap production of large area photovoltaic devices on low cost polymer substrates. Based on interconnected networks of p-type polymers with percolating electron conducting C_60 derivatives, our group recently achieved more than 2.5 % solar efficiency in devices of less than 100 nm thickness of the absorber layer, in which only a small portion of the solar light is absorbed [2].

The key for improving organic solar cell efficiencies was the fabrication of an interconnected network structure of p- and n-type materials to form a so-called bulk hetero junction. In such devices the flat interface of classical organic solar cells [3] is replaced by an extremely rough network such as also used in modern sensitization solar cells [4]. Photo induced electron transfer has been demonstrated in composites of conjugated polymer/CdS and CdSe nanocrystals and conjugated polymer/TiO_2 composites. However, all as yet used materials in such composite structures exhibit relatively low absorption coefficients in the order of only some 10^4 cm^{-1}. Also, their band gap does not match the solar spectrum very well. In order to overcome this problem we decided to replace the electron transporting fullerene derivative by classical semiconductor nanodots. Because of the high absorbance coefficient and the wide absorbance edge (300-825 nm), the ternary compound CuInS_2 (CIS) is a leading material for solar energy harvesting. Below a size-regime of 10 nm, the opto-electronical properties of the particles changes fundamentally. Unfortunately, the high surface energies of nanocrystalline particles leads to an easily growing up of the size in dispersions. Preparation of nanocrystalline samples in polymer blends that are uniform in composition, size and surface chemistry is a goal of this paper. These hybrid organic-inorganic materials combine the unique properties of nanocrystals with the advantages of plastic solar cells. The first part of these paper will cover optical and solar cell characterisation of synthesized CuInS_2. In the second part of the paper, we will discuss several device architectures.

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