Metal Semiconductor Nanocomposite for Plasmonic Solar Cell

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The growing world energy demands, limited fossil fuel resources, as well as considerations based on greenhouse gas emissions, are motivating the search for viable renewable energy sources. Among the possibilities, solar energy conversion is of great interest because it is globally available, inexhaustible, and electrical energy can be converted to other energy currencies such as hydrogen. Solar cell is a several decades old research area continuing for the quest of harvesting solar energy and efforts in this field has made solar cells commercially available although the efficiency is still very less. Colloidal nanocrystal based organic solar cells are envisaged to be a cost effective alternative to conventional inorganic cells. The photo-emission and absorption of semiconductor nanocrystals is tunable by the size as a result of quantum confinement effects. To increase the efficiency, solar cells with semiconductor nanocrystals and conducting polymer have been devised but this approach has two shortcomings: firstly, a surfactant must be used to control nanocrystal size and shape. Some of the surfactant gets incorporated into the final nanocrystal and conjugated polymer mix, which inhibits efficient charge transfer. Secondly, the mixing approach requires the use of co-solvents, which can adversely effects nanocrystal solubility and polymer chain orientation. Although the organic composite yielded few promising result in efficiency, the power generated by per square meter solar panel to its production cost is still high owing to less efficiency of the materials. Also the stability issues of the organic materials is a big challenge for effective large scale application of such organic composite solar cells and hence still the inorganic materials are in practical application. The efficiency of the solar cells studied largely hindered by the scattering loss of solar radiation which effectively reduces the absorption of the photons by the active materials. The scattering from metal nanoparticles near their localized plasmon resonance is a promising way of increasing the light absorption in thin-film solar cells. Few reports of higher efficient solar cells used a very thin/nanoparticles layer of metal. Light incident on the metal surface gets scattered by the metal layer and thus increases the absorbance which ultimately yield better efficiency. The improved absorption on the active materials layer alone can improve the efficiency of the solar cells by manifolds. Application of very thin (~1nm) metal layer on semiconductor nanoparticles can achieve the highest absorbance of the visible spectrum of solar energy if the size of the composite can be tuned to perfection. Our research is focused on synthesis of such semiconductor/metal hetero nanostructure and their size control to perfection to achieve the highest absorbance which will ultimately lead to highly efficient solar cell.

In this paper we report synthesis of semiconductor /metal core shell (CdS/Ag) nanocomposite structure. The samples are characterized by X-ray diffraction (XRD), Uv-vis absorption spectroscopy, transmission electron microscopy (TEM) I-V characteristics under dark and light current. The high current under illumination in CdS/Ag nanostructure indicates the applicability of such structure in solar energy harvesting.

Keywords: solar cell, nanocomposite, Plasmon, core shell structure