Cheap and weak/low light effective Sb_2S_3 – based hybrid solar cell

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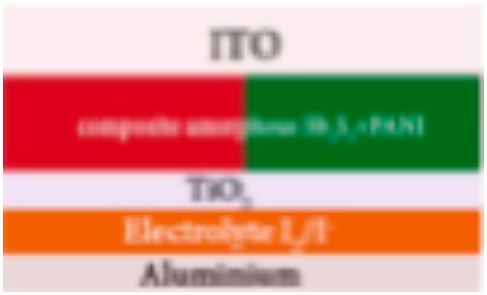
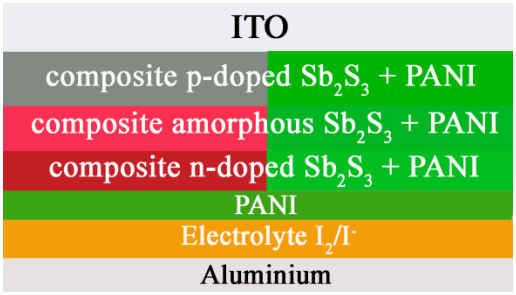
There are certain facts about solar cells most scientists in this field agree with. One of them is that the low efficiency and high cost of currently used solar photovoltaic systems are one of the main reasons for their reduced availability and usability; they are inaccessible to the common man. Also, the current and future design of solar cells depends not only on the light and its distribution (indoors 1-10 W/m^2 and outdoors 100-1000 W/m^2), but on the materials and technologies used as well. The efficiency of photovoltaic cells is usually reported for Standard Testing Conditions (STC) only, which implies irradiation of 1000 W/m^2, spectral composition of Air Mass 1.5 (AM 1.5) and solar cell temperature of 25°C. But, the fact is that the energy output of photovoltaic systems strongly depends on irradiation conditions and also that most of the total solar irradiation that reaches the Earth is below 1000 W/m^2 the value used for standard testing conditions (STC). [1-6] Therefore, the research related to the low light intensity (conditions present almost everywhere) is of crucial importance. In that respect, perhaps a solid efficiency of cells at low light intensities with cheap technology could compensate higher efficiency in rare and extreme conditions of 1 sun (irradiation of 1000 W/m^2, module temperature of 25°C, and standard spectrum AM 1.5). Standard requirements (conditions) for low-intensity lights have not been established yet but they are very important and there is a great possibility that, at certain spectral distribution of low intensity light, cells of no less efficiency than those operating under extreme condition of 1 sun can be designed. Light at different intensities cannot be changed, but different lens systems can change its distribution at wavelengths. As soon as one manages to understand how to change the spectral light distribution and determine the most optimum one for the fabricated low-light intensity cells of high efficiency, this knowledge will be incorporated into future cell technology.

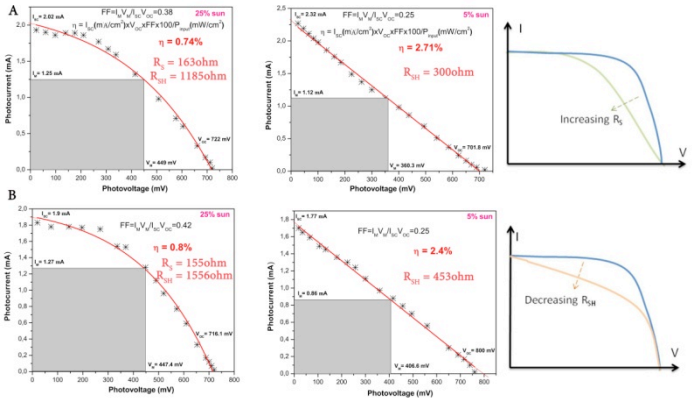
We report here on an inexpensive solar cell made entirely of a synthesized material (indium tin oxide/amorphous Sb_2S_3 + polyaniline composite/TiO2 /electrolyte). The cell has a solid efficiency of around 2.5% at very low light intensity of only 5% sun. We also reported that the cheap p- and n-doped Sb_2S_3-based hybrid solar cell made entirely of synthesized material works as a an electricity generator, and exhibits very high efficiency (around 8-9%) at very low light intensity of 5% sun. The efficiency of the designed cell is higher at weaker light intensity, probably due to different distribution of the visible part of the spectrum at the wavelengths that we have achieved with different lens systems, a plano-convex and a biconvex lens, respectively. According to the analysis, high shunt resistance (even under STC conditions) at illumination of 5% sun, causes a linear slope in the illuminated current-voltage curve. The possible electronic processes in the cell, such as electron/photon transfer were very similar to those occurring in amorphous-silicon-based thin film solar cells.

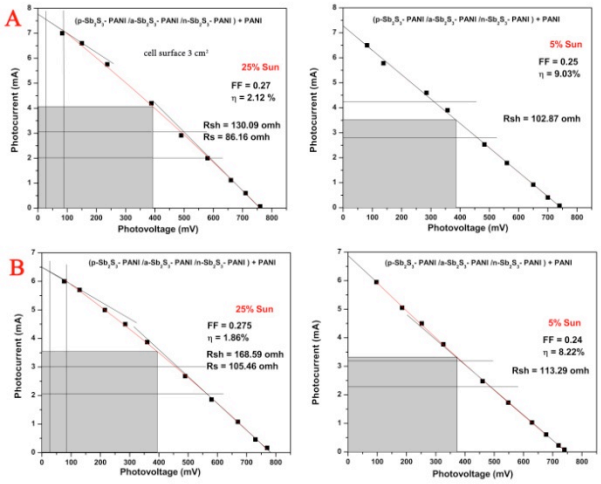
A schematic of designed cells

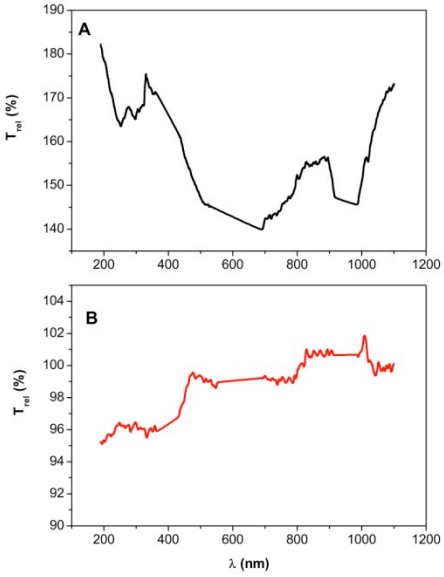




Illuminated I-V curves for the solar cells







areas

Different permeability of lenses in different of the spectrum

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