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Fabrication and characterization of multilayer solar cells

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The solar cells based on copper oxide and zinc oxide are a promising alternative to conventional silicon cells because of the relatively low cost of production and the theoretical efficiency of approx. 16% [1-3].

First of all, this paper focuses on the characteristics of the ZnO layer - *n*-type, and Cu_2O/CuO - *p*-type semiconductors prepared by electrodeposition, which allows to create transparent semiconductor layers with good optoelectronic properties [4].

Secondly, fabrication of perovskites layers which acts as light absorber [5].

Perovskites having the composition of $CH_3NH_3PbX_3$ (X = I, Br) are examined as an attractive absorbing materials for use in low cost solar cells with high efficiency. For about five years, there has been an increase in energy conversion efficiency of these materials, which shows remarkable potential of their usage. However, in most devices, including thin-film simplest planar structure identifying the basic working mechanisms, which are still being debated, will be crucial to design the optimum device configuration and maximize solar cell efficiencies. Combining different methods of production with relatively low cost such as spin coating for perovskite and electrolytic deposition for metal oxides semiconductors provides possibility to create multifunctional layers and improve efficiency and reduce cost of solar cells. Cu_2O layers were prepared on pre-cleaned Fluorine doped Tin Oxide (FTO) glass plate by electro deposition using platinum as counter electrode, ZnO layers were galvanostatically electro-doposited and $CH_3NH_3PbX_3$ was spin-coated under 100°C.

Cuprous (I) oxide (Cu_2O) semiconductors are a promising candidates of an all functional-oxide solar cell material because of its photo electronic properties such as proper energy band gap of 2.1 eV, environmentally friendly properties such as non-toxicity and low material cost [1,2]. It was proven that a solar cell devices based on the ZnO/Cu_2O may be produced at ambient conditions. ZnO has been a preferred candidate of window layer of solar cell because of its wide and direct band gap of 3.37 eV at room temperature, good diode characteristics in the dark especially its very high photocurrent [7].

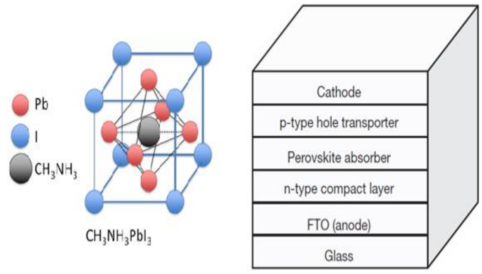

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Figure 1. Concept of solar cell with perovskite absorber.

All the crystalline components in the Cu_2O and ZnO thin films were investigated by XRD, diffraction peaks corresponding to Cu_2O and ZnO were observed in thin films, which consisted of cupric phase with monoclinic system. It was shown that the solar cell devices have the structures of crys-Cu(001)/^{p} poly-Cu_2O/Ag and poly-Cu/^{p}-poly-Cu_2O/Ag, which convert solar energy into electrical energy. Additianal the layers deposited on FTO were studied by XPS measurements. The core levels S 2p, Cu 2 p, O 1s, C 1s, Zn 2p spectra and the Cu Auger spectrum were measured. During formation of the layer on the surface of FTO all processes proceed in an open medium; therefore, it is not possible to avoid ambient effects. Since the surface of this layer is active, it adsorbs oxygen, water, and other contaminants. Therefore the surface of the layer can differ from the macrostructure and chemical composition of the entire layer. Finally the analysis of the current–voltage characteristics was applied to determine the values of electrical parameters of the solar cells [6,7].

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