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ORGANIC AND INORGANIC SEMICONDUCTORS FOR SOLAR CELLS: IMPROVING STABILITY AND EFFICIENCY

Abdieva D.

In work are given examples of methods of solar elements on the basis of various semiconductors. It described Properties of a solar element. New development is discussed in the field of various solar elements.

This article seeks to develop increasing efficiency of the solar battery which will be used and extended in the future. We considered different methods researches of solar elements. This model has to be sensible nevertheless the flexible. Intention consists that this model is available as the basis for solar more advanced research of increasing efficiency and development. The model has to allow ease in switching materials in existing design to execute that - if the type checks just as more the detailed and subtle differences in device projects. The desire consisted in finding a condition of high efficiency in solar batteries in order that the developed model could be closely to a condition.

Nowadays photo cells on the basis of inorganic semiconductors are developed and widely used in various areas of a national economy. Development of science and equipment of semiconductors allowed creating already today photo cells with the efficiency coefficient (E) equal to 20%. However the photo-electric power still didn't pass to averages and big capacities because of the high cost of receiving high-quality photo cells. Along with further development of photo cells on the basis of the inorganic semiconductors, directed on increase of the efficiency coefficient and decrease of their specific cost, almost important is search, development and creation of photo cells on the basis of polymeric structures with the interfaced communications. Priority in this direction is creation of highly effective, cheap photo cells, and here development and receiving thin-film elements on the basis of organic semiconductor materials has important value.

It is known that the photocell operation is based on the photovoltaic effect, which is due to the spatial separation of the non-equilibrium electrons and holes. For the effective work of photovoltaic effect as photocell, it is required such a choice of the photosensitive material and the electrodes, which could provide a sufficient magnitude of not only photo-voltage, but the photo-current, since from the magnitude of Latter depends sensitivity of the photocell. Photo voltage is detected in a number of low molecular weight organic compounds, but solar cells have not been developed based on them, what can be associated with the low value of the photocurrent.

Only in recent years there were works on creation of photo cells on the basis of low-molecular organic semiconductors – phthalocyanine and other dyes.

Structurally known photo cells on the basis of organic materials consist, as a rule, of a transparent substrate, a transparent (translucent) first electro-conductive layer, the organic photoconductor, the second electro-conductive layer and electrodes.

As a rule, in this case between one of electro-conductive layers and the organic semiconductor transition, like metal semiconductor (Schott's transition) is formed. Authors of work 10 describe the multilayered organic photo cell consisting of layers of dyes, possessing conductivity of p-and n- type. Multilayered organic photo cells where the potential barrier arises on border of layers of the organic materials being the donor and an acceptor of electrons respectively are known also. In these converters, at least, one of organic layers can absorb light with a length of wave of 350-1000 nanometers.

Ways of receiving and parameters of various photo cells on the basis of organic polymeric materials. The technology of receiving organic polymeric photo cells is various, demanding in one cases chemical, thermal and radiation treatment of a material, in others - creations of multicomponent systems.

Usually as a photosensitive material at creation of an organic photo cell, it is used a polymeric matrix with an additive of various low-molecular connections. In is described the organic photo converter on the basis of poly- carbazole with an additive of a low-molecular acceptor of TNF. The polymeric donor and low-molecular acceptor are taken in a weight ratio 50:1. The electro conductive layers, which thickness makes 5000 A, are received from a tin oxide (90%) and oxides India (10%). The photoconductive layer is received from polymer and acceptor solution in tetra hydro furan. Dependence of photo voltage of idling on illumination in this case is the same, as in known photo cells. The potential barrier dividing non-equilibrium electrons and holes arises on border polymer – an electro conductive layer (oxide): and, polymer possesses conductivity of p-of type, and oxide - n-type.

At a choice of a photosensitive material for creation of photo cells along with photosensitivity such physical and chemical properties, as solubility, film formation and adhesion of the photoconductor have important value. Authors of this work as a photosensitive material used PEPK, possessing good solubility in many organic solvents (benzene, the toluene, the chlorinated aromatic and aliphatic hydrocarbons, acetone, radio solvents) high film-forming and adhesion properties, with an additive of a low-molecular acceptor, with various concentrations in relation to polymer. It should be noted that pure (without an additive) polymer is photosensitive only in ultraviolet area to 300 nanometers. Introduction of 3rd weight % of a sensitizer increases photosensitivity as in own area of absorption of polymer, and expands its spectral distribution in visible area to 600 nanometers.

The received results on research of photo cells on the basis of PEPK show that the last is one of perspective photosensitive materials. At the same time increase of efficiency of a photo cell is directly connected with increase in size of photocurrent which in turn depends on value of conductivity of a material. Conductivity of the photoconductor can be raised as follows: a) introduction of high-conductivity additives (graphite, metals), that is creation of composites; b) determination of optimum thickness of films of the photoconductor.

For receiving this element on a single-crystal plate of n-Ga As by the method of vacuum evaporation is besieged a film of copper phthalocyanine 50 nanometers thick. On a film of the organic semiconductor in turn, by the same method, is put a silver film. The coefficient of a transmission of this film of silver was equal 10%. From the back party the plate of arsenide of gallium also became covered by a silver film. By researches it was established that efficiency of this solar element is equal 4% for an incident light. In recent years the aspiration of researchers to increase efficiency of especially organic solar elements led to creation of so-called volume hetero structures, or hetero junctions, on the basis of donor-acceptor systems. Donors and acceptors of electrons can be used both low-molecular materials, and polymers. In this case donors and acceptors spatially aren't divided, but mixed up. Electric field which would divide the photo generated electrons and holes in space, is created at the expense of selection of electrodes with various work of an exit. For example, as the anode is used varying-out glass (ITO), and as the cathode are used Ag, Al, Ca, Ba, Mg, etc.. The structure of this solar element is similar to a design given in fig. 1. In solar elements with a volume hetero junction, the active area is the all volume of the semiconductor, and not just the p-n area of transition or the area which has been grown poor by carriers of charges. In some polymeric solar elements efficiency reached 5%. Thus, in this work, the review of works of authors, devoted to properties of the organic solar elements, containing transitions of Schott, organic p-n transitions and p-n transitions of organic and inorganic semiconductors is submitted. Besides, are provided structure and properties of organic solar elements on the basis of volume hetero structures which, undoubtedly, can be considered in practice as the most perspective organic elements.

Research manager: Nogai A. S.