



RESULTS OF THE STUDY OF THE PHOTOSENSITIVITY SPECTRA OF AU-BASED OXIDE-N-GAP SCHOTTKY BARRIERS

D.Melebayev¹, Yu.V. Rud³, V.Yu. Rud², I.A. Shaposhnikov², M. Serginov¹

¹Physico-Mathematical Institute, Turkmenistan Ashgabat

²A.F. Ioffe Physico-Technical Institute, Russia, St-Petersburg

³St-Petersburg state polytechnic university

It is expected that the thin-film modules will dominate new markets. Therefore the work with new materials and structures continues, in order to develop new technologies and improve solar cells. To our opinion, his work opens possibility of using the new material and photosensitive structures based on it as thin film solar energy photoconverters.

Currently in Russia, Ukraine, and Kyrgyzstan exist and develop programs of development of alternative energy, including solar power, a number of joint projects with foreign firms, which are practically engaged in supplying silicon feedstock and replication of foreign equipment and technology.

In the European Union since 1997, the annual cost of creating photovoltaic technologies estimated sum of 100 million U.S. dollars; Germany had the largest contribution — about \$ 40 million. To coordinate research in the field of solar energy, a special commission with headquarters in Brussels.

It is expected that the thin-film modules will dominate new markets. German market is also expected to tilt toward the thin film photovoltaic modules due to the gradual reduction of feed-in tariffs for electricity produced from photovoltaic plants, which leads to a desire to reduce capital costs. The main manufacturer of thin-film modules — the American company United Solar, which produced 22.0 MW of modules in a three-layer of amorphous silicon. This paper considers the photosensitivity (PS) Au-oxide-n-GaP structures in the photon energy to determine the bandgap oxide Ga_2O_3 (E_{gox}) and elucidate the influence of iron oxide (Fe_2O_3) on the photocurrent spectrum of the Schottky barriers. Technology for manufacturing nanostructured Schottky photodiodes based on n-GaP discussed in detail in [1]. After chemical etching with a mixture of Br_2 (4 %) + $\text{C}_2\text{H}_5\text{OH}$ (96 %) followed by washing with ethanol, the surface of n-GaP was treated with ethanolic sodium bromide, iron ($\text{FeBr}_2 \cdot 6\text{H}_2\text{O}$). On the treated surface consistently created nanooxidized GaP layer (Ga_2O_3) optimal thickness $\delta = 3\text{--}6$ nm, then the barrier contact (BC) application Au nanolayer thickness of 12–14 nm. Oxide layer and BC were created by a chemical method [2]. Barrier contact area was $0,10 \div 0,40$ cm². Structural diagram and basic experimental results are illustrated in Figure 1.

In the visible (2–3 eV) and also in ultra violence (UV) (4,5–6,2 eV) regions of the spectrum we find new patterns (Fig. b). In the long-wavelength part of the spectrum there is a maximum of $h\nu_{m1} = 2,35$ eV. This is apparently due to the formation of iron oxide (Fe_2O_3) $E_{\text{gox}} \approx 2,3$ eV to the interface (Fig. b). In the UV part of the spectrum in the range of 5,0–6,2 eV is observed growth of photosensitivity with increasing of energy. When illuminated structure Au-oxide-n-GaP, the oxide layer Ga_2O_3 is doped by iron and gold Au nanolayer are influenced by the high internal electric field of the space charge and under the action of high-energy photons with $h\nu > 5$ eV in the dielectric (oxide) photocurrent arises due to photoexcitation of carriers charge of contact and movement of this charges through permitted zones [4].

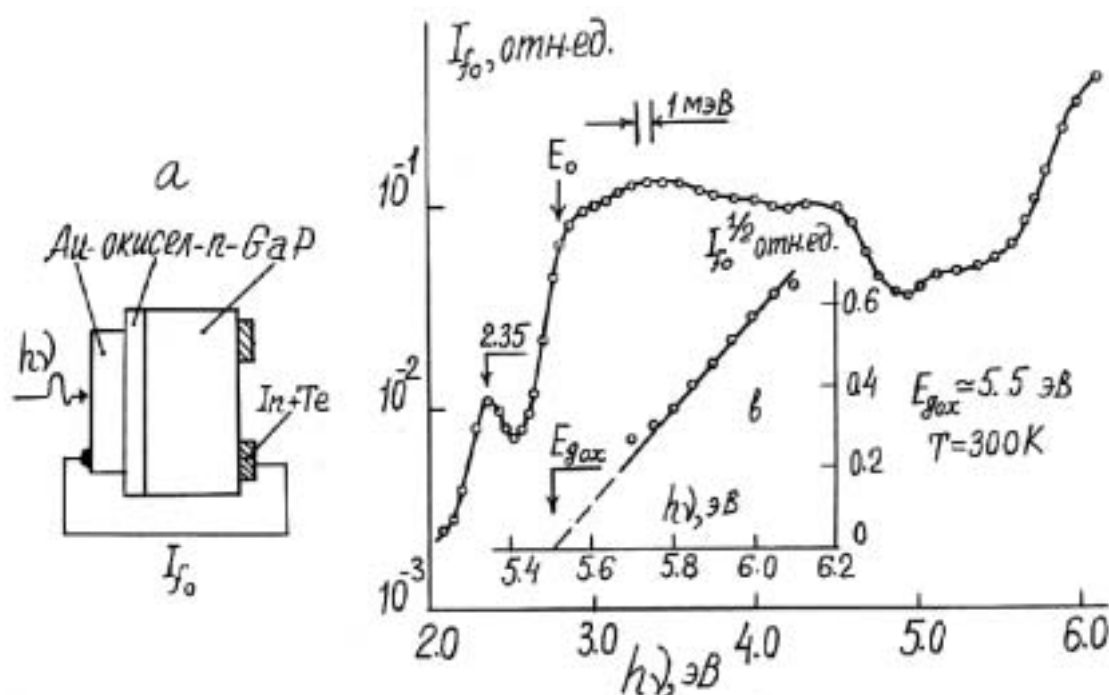


Figure 1. The scheme of illumination and the construction of structures (a), Spectral dependences of the relative quantum efficiency of photoconversion of Shottky barrier (b).

When $h\nu > 5$ eV, the photocurrent in the range of 5,0–6,2 eV was exponential (Fig. b). It is important to emphasize that the experimental dependence $I_{f_0}^{1/2}$ from $h\nu$ (Fig. b) was linear in the range $h\nu = 5,7$ – $6,1$ eV. This allows using widely known methods [3] to determine the band gap of the oxide Ga_2O_3 , formed on the surface of GaP. In our data, the value of $E_{g_{ox}}$ for Ga_2O_3 was found to be $E_{g_{ox}} = 5,5 \pm 0,05$ eV at 300 K. Thus, the formation on the surface of GaP layer nanooxide iron creates nanostructure Au- Ga_2O_3 -n-GaP specific properties are of great practical importance.

References:

- [1]. D.Melebayev Proceedings of international conference «Nanotechnology of functional materials». St.-Petersburg, 2010, pp. 115–116. (In Russian).
- [2]. D.Melebayev, G.D. Melebayeva, V.Yu. Rud', Yu.V. Rud'. J. Tech. Phys., V. 78, 1, pp. 137–142 (2008). (In Russian).
- [3]. A. Rau, J. Phys. Chem. Sol. 27, 761 (1966).
- [4]. S. M. Sze, Physics of Semiconductors Devices (Wiley Intersci., New York, 1981).