The effect of surface modification on the physical properties of metal-ZnSe junctions

S. Chusnutdinow[1], V.P. Makhniy[2], M. Aleszkiewicz[1], W. Zaleszczyk[1], G. Karczewski[1] and M.M. Slotov[2]

[1] *Institute of Physics, PAS, Al. Lotników 32/46, 02-668 Warsaw, Poland*
[2] *Yuri Fedkovych Chernivtsi National University, 2 Kotsyubynsky Str., 58012 Chernivtsi, Ukraine.*

Prospects of employing zinc selenide (ZnSe) in the short-wave optoelectronics stimulates research aimed at improving technology and parameters of diode structures based on this wide-energy gap semiconductor. In particular, metal-ZnSe contacts focus a lot of attention because they can be used as broadband prebreakdown electroluminescent diode (PED) and UV photodetectors. One of the paths leading to improvement and optimization of optoelectronic parameters of metal-semiconductor junctions is a modification of the semiconductor surface. A technological method enabling PED with homogeneous emission and high temperature stability has been proposed [1]. In the present work we describe an effect of surface treatment on optical and optoelectronic properties of metal-ZnSe contacts.

As semiconductor substrates we used wafers of low resistance, n-type, Te-doped ZnSe bulk monocrystals. The substrates were chemically treated in different solutions. In result the surfaces became mirror-like (type 1) or matt (type 2). The ohmic contacts were formed on the back-side of the wafers. On the front-side rectifying contact were deposited. For rectifying contacts semi-transparent layers of Ni were employed. The Ni layers exhibit high transmittance in the energy range from 1 eV to 6 eV and they form high potential barrier φ_0 on ZnSe surfaces. Under illumination the type 2 surface modified junctions generate larger photovoltaic voltages and currents and they are more sensitive to optical radiation in the short-wavelength region as compared to the type 1 junctions. We note also reduced reverse current at the same voltage. In result signal-to-noise ratio improves.

Changes in the parameters and characteristics of Ni-ZnSe junctions, can be explained by formation of a quantum-dimensional structure on the surface after the modification procedure. This is confirmed by AFM studies, which show the presence of grains with lateral dimensions of 30-300 nm on the type 2 surface. The smallest grains are responsible for a wide spectral band observed in photoluminescence at 3.4 eV, i.e., at much higher energy than the energy gap of ZnSe, $E_g \approx 2.7$ eV. Nanograins of larger size cause the significant increase in the short-wave sensitivity. Similar effect is observed in Si-textured photodetectors.

In the paper we will discuss possible ways of further improvement of optoelectronic parameters and characteristics of metal-semiconductor junctions.

[1] V.P. Makhniy, V.E. Baraniuk. Author's certificate SU 1835986A1, 04.06.1991.