Investigation of PL Spectra of Porous Silicon with Inclusions of Organic Molecules

V.G. LYTOVCHENKO[1], T.I. GORBANYUK[1], V.S. SOLNTSEV[1], L.L. DAVTIAN[2], O.V. DULTSEVA[2]

[1]*V.Lashkaryov Institute of Semiconductor Physics of NAS Ukraine, Kyiv, Ukraine, tatyanagor@mail.ru*

[2]*P.L. Shupyk National Medical Academy of Postgraduate Education, Kyiv, Ukraine*

Development of biosensors based on nanostructured solid matrix is actual and promising task. One of the most suitable materials for this purpose is silicon. First, the technology for producing of porous silicon is well developed, that allows to obtain the thin nanostructural layers with reproducible parameters, namely, thickness, pore size, surface morphology, etc. Second, the surface of porous silicon absorbs and good keeps the biological complexes which can be sensitive to various kinds of toxic molecules. Thus such sensor systems can monitor air and water for determination of different toxic substances and certain chemicals. Furthermore, in medicine the sensors based on porous silicon with bio-organic complexes in pores can be used for laboratory analysis, to control the intensive care, where certain parameters must be monitored in the dynamics. In this paper features of photoluminescence spectra and the current-voltage characteristics have been studied with the introduction of various organic molecules in the pores.

In particular, PL spectra of thin films of nanoporous silicon with porosity of 40-89% have been investigated at room temperature. It was found that the layers of porous silicon with porosity about 40 % have more intensive photoluminescence (PL) than that with porosity in range of 50-80 %. Furthermore, it was found that the adsorption of methionine molecules causes a shift of the right wing of PL spectrum to shorter wavelengths. While the adsorption of molecules of glycine leads to a shift of PL in the opposite direction to longer wavelengths. It may be due to a decrease of the size of nc-Si caused by the local oxidation of Si nanocrystals (nc-Si) during the interaction with adsorbed methionine molecules (soft an organic oxidant). On the other hand, the change of the intensity of room temperature PL spectra and its shift to the short-wavelength region upon adsorption of glycine (organic reducers) are also observed. The medical films based on porous silicon as a delivery system of active substances have also been investigated. Medical tapes are compounds of nanoparticles with polymers. Three types of samples were examined: (1) the solution of dimethyl sulfoxide (CH3)2SO and nanoporous silicon was injected into the polymer basis; (2) nanoporous silicon was injected as a suspension of liquid paraffin oil into polymer base; (3) nanoporous silicon was injected as a suspension of liquid paraffin oil into polymer base, and then added the dimethyl sulfoxide and homogenized. It was found that in the first and second cases, a gel is formed (Fig. 1, a, b). When heated to 55 C gel becomes transparent, but upon cooling restores its original condition. But in the third case, the film consists of irregularly shaped particles forming a mosaic structure with an average size of 1-5 microns. Microstructure of the samples was studied using an optical microscope MBS-10 digital camera TUSCAN 5 MPixel in mode of translucence and light reflection.

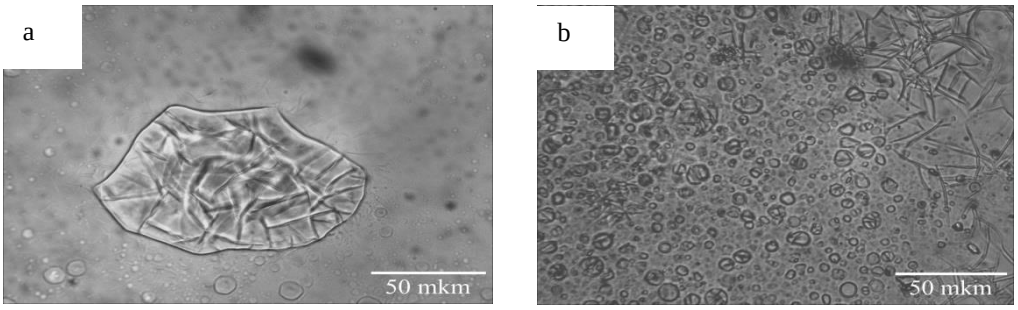

Fig. 1. Polymer matrix based on solutions of porous silicon and (a) dimethyl sulfoxide; (b) liquid paraffin