POROUS SILICON SURFACE MODIFIED AND INCORPORATED BY ZnO

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The influence of formation conditions on the surface morphology and spectra of photoluminescence (PL) of porous silicon (PS) are researched. The photoluminescence (PL) and photoluminescence excitation spectra (PLE) and electron and atomic force microscopy were investigated. The results of low-dimension electro-chemically and chemically etched PS, ZnO - PS heterostructures studies, obtained by chemical etching method and formation of ZnO nanoclusters on the PS surface (deposition method and solution gas transport reactions) are representing.

One of the way on nanomaterials creation with improved functional properties is a combination of different nature substances on molecular, nano- and submicron levels [1], in particular, with the nanostructured conductive inorganic semiconductor matrix. Prospects for the application of various porous structures, in particular based on silicon are founded on the properties of these structures in relation to detecting substances and quantum size effect [2].

- **Concept**: practical implementation of sensor systems with unique capabilities on porous silicon (PS).
- **Concept**: creation of nanomaterials (porous silicon (PS)) with improved functional properties using semiconductor materials (ZnO).
- **Means (method, technique)**: The photoluminescence (PL), photoluminescence excitation spectra (PLE), luminescence kinetic characteristics, scanning electron and atomic force microscopy.
- **The aim**: the development of new hybrid structures on the PS base with wide-bandgap ZnO semiconductor.
- **Therefore** - the main goal of this work was actual search for new and improvement of existing methods of creating hybrid graded-gap structures and obtaining thin-film heterostructures based on semiconductors with quantum-dimensional effects with complex nanostructured systems that exhibit a number of interesting properties.
- **Prospect**: a widely broad study of various properties of the PS has opened prospects for its numerous alternative applications in areas such as solar cells, biotechnology, sensors.

Results

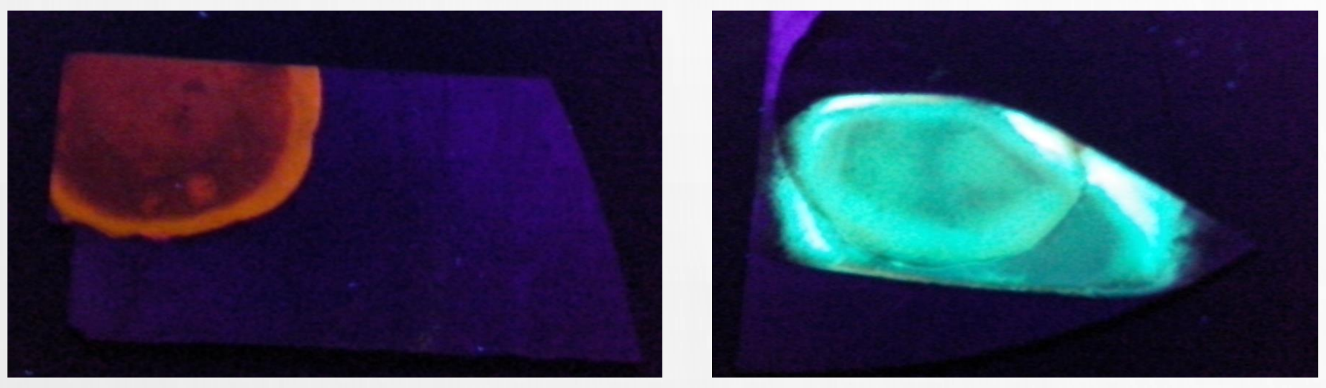

Fig. 1. PS and PS - nanosized ZnO with p-type conductivity deposited by electrochemical technique without previous substrate treatment.

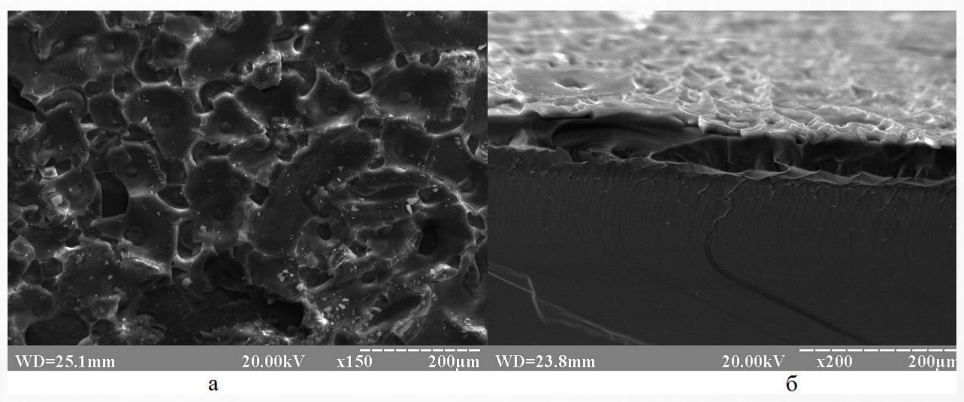

Fig. 2. a) electron-scanning microscope PS-pSi surface image; b) PS-pSi cross-section image)

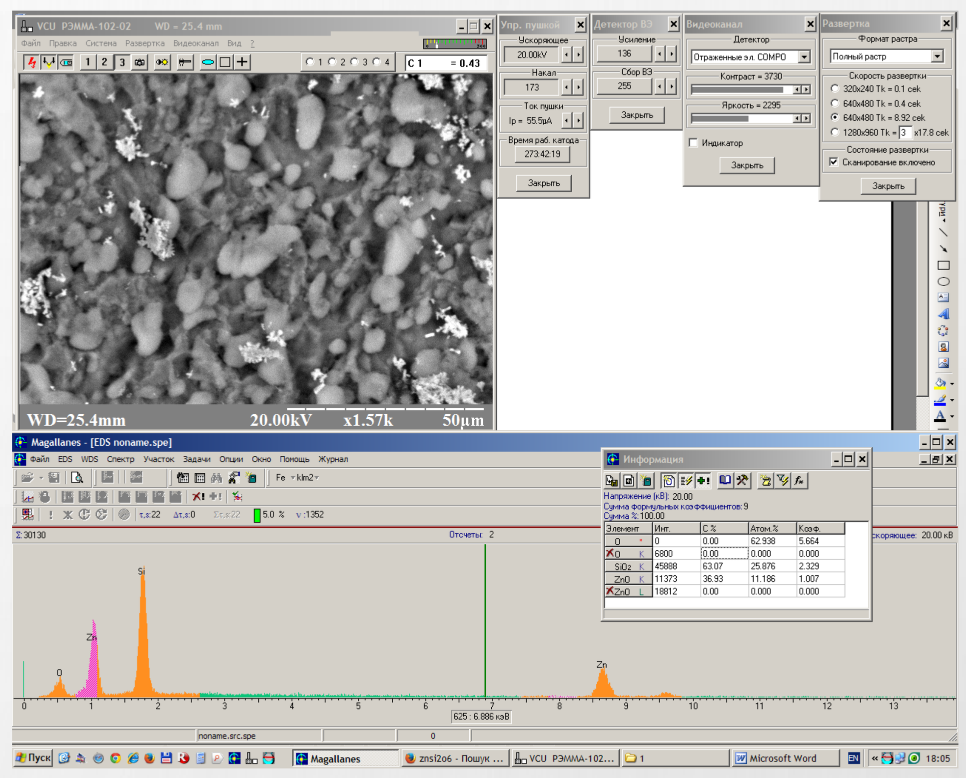

Fig. 6. PS surface on the p-type silicon substrate incorporated by nanosized ZnO and mass-analisys

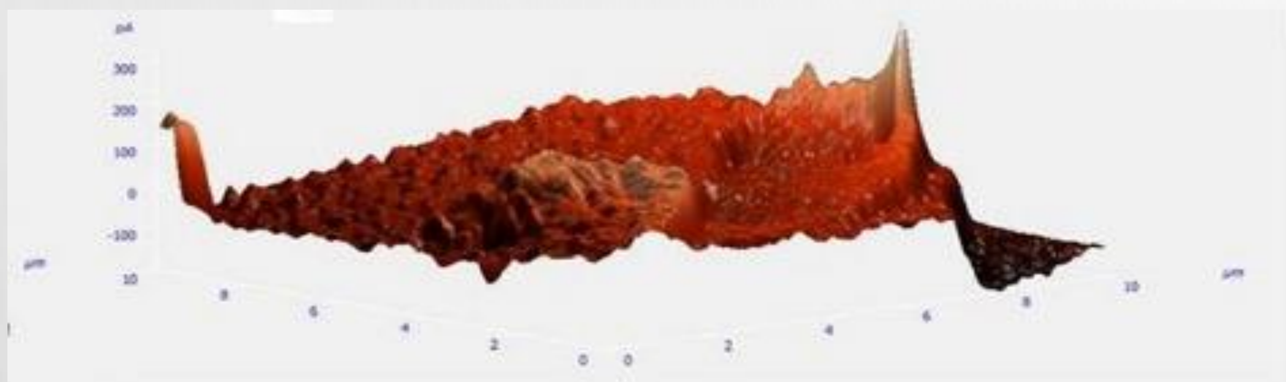

Fig. 4. PS obtained by chemical etching AFM 3D-image.

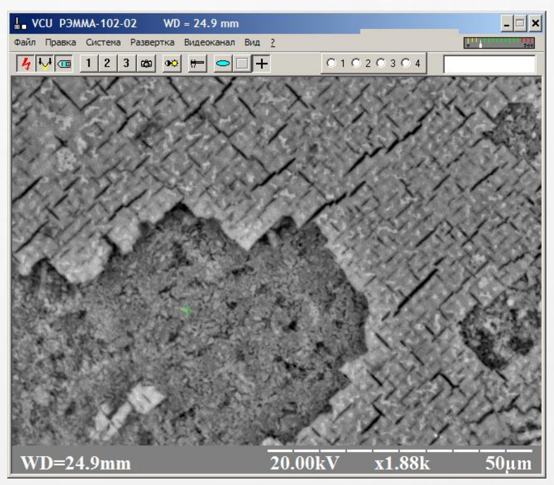

Fig. 5. PS surface on the p-type silicon substrate incorporated by nanosized ZnO.

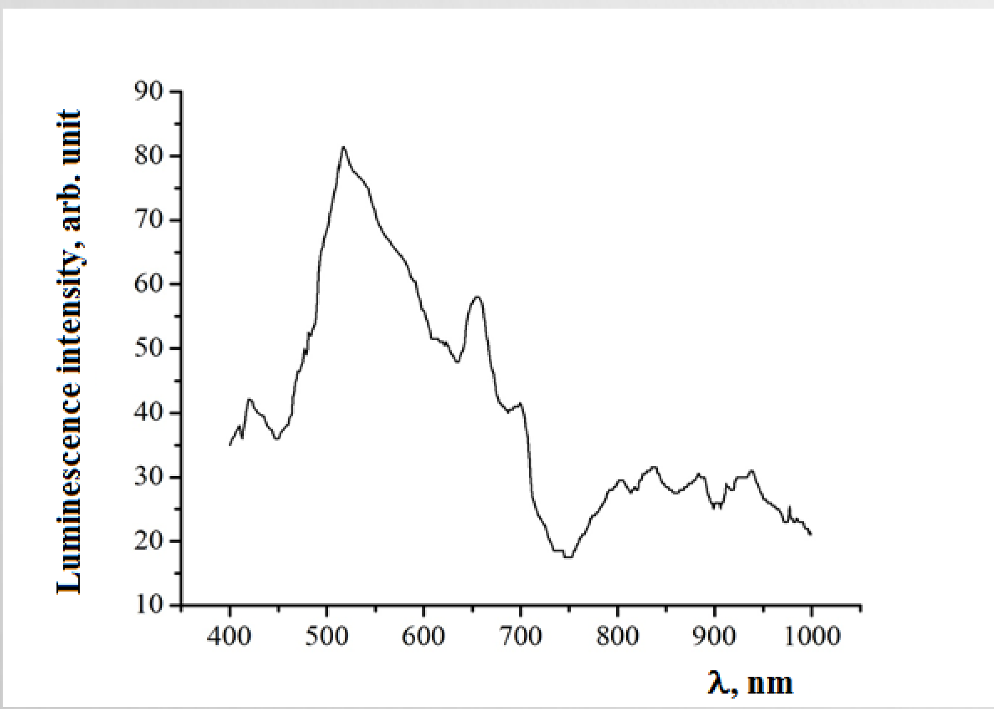

Fig. 7. The photoluminescence spectra of PS (n-type Si substrate) measured at T = 77 K.

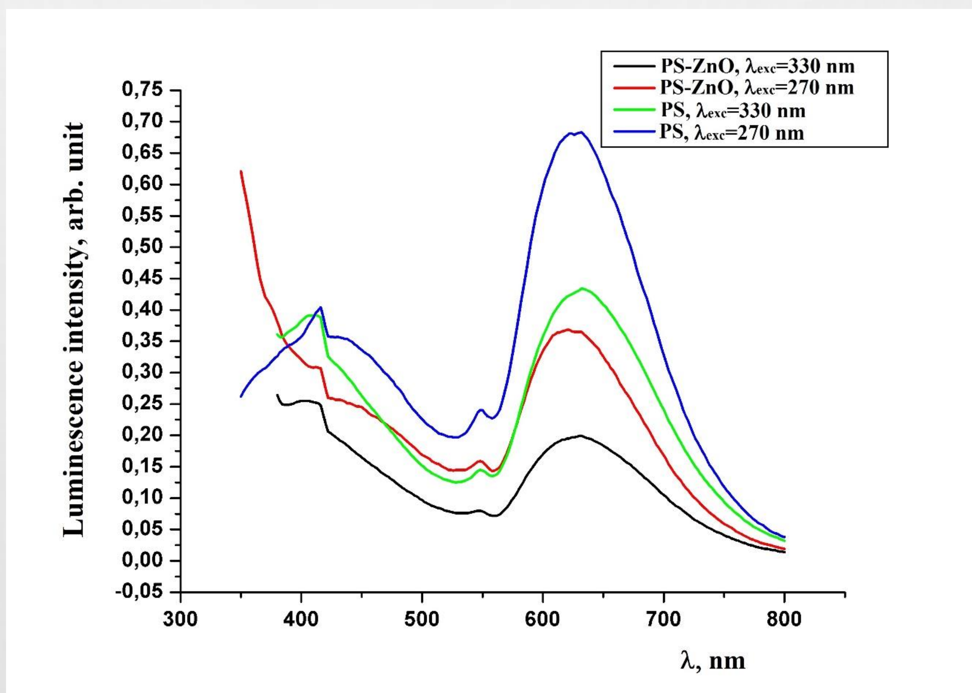

Fig. 8. The photoluminescence spectra of PS-ZnO (n-type Si substrate) measured at T = 293 K.

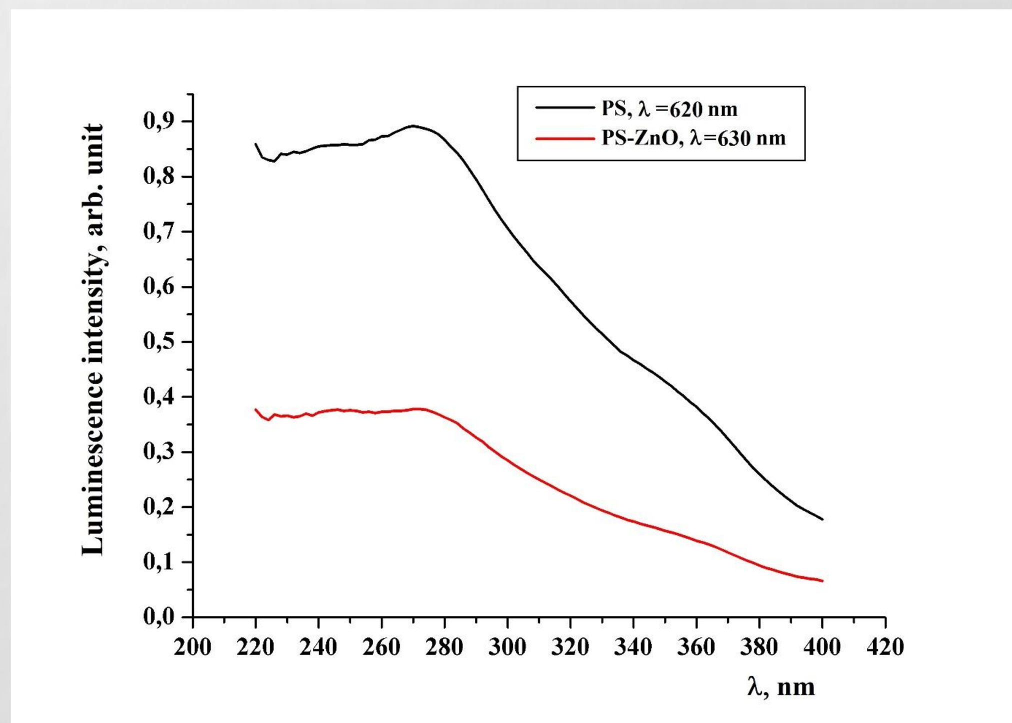

Fig. 9. The photoluminescence excitation spectra of PS-ZnO (n-type Si substrate) measured at T = 293 K.

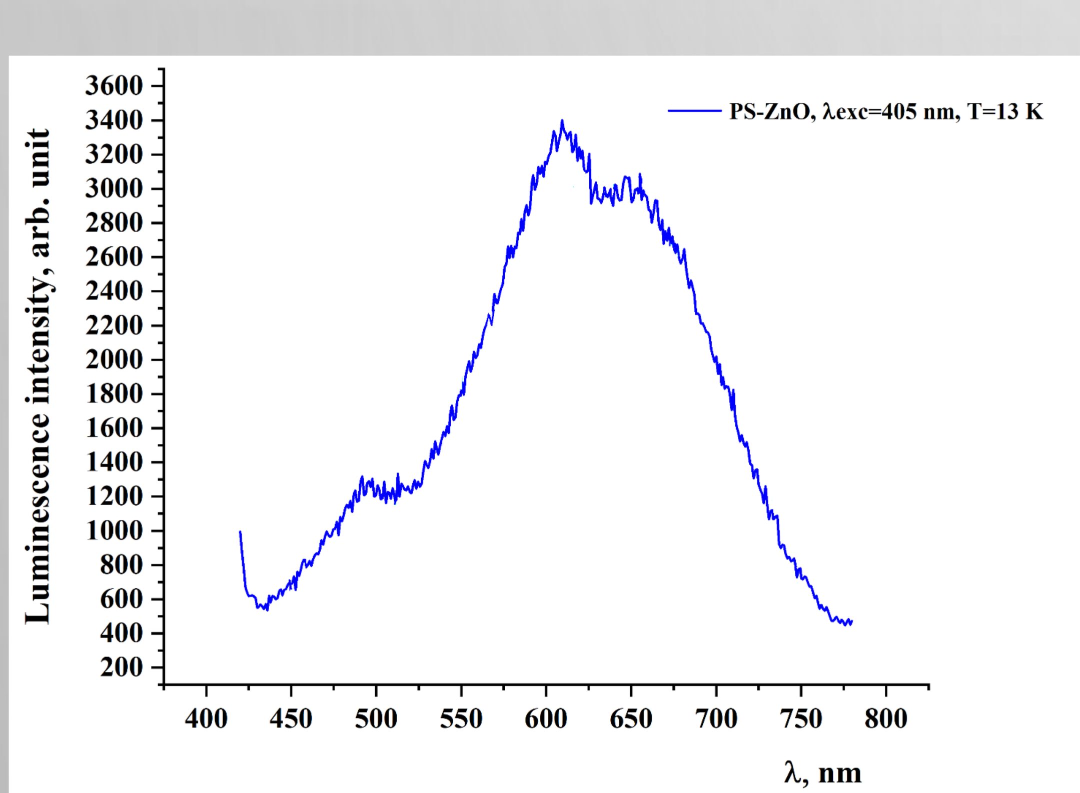

Fig. 10. The photoluminescence spectra of PS-ZnO (n-type Si substrate) measured at T = 13 K.

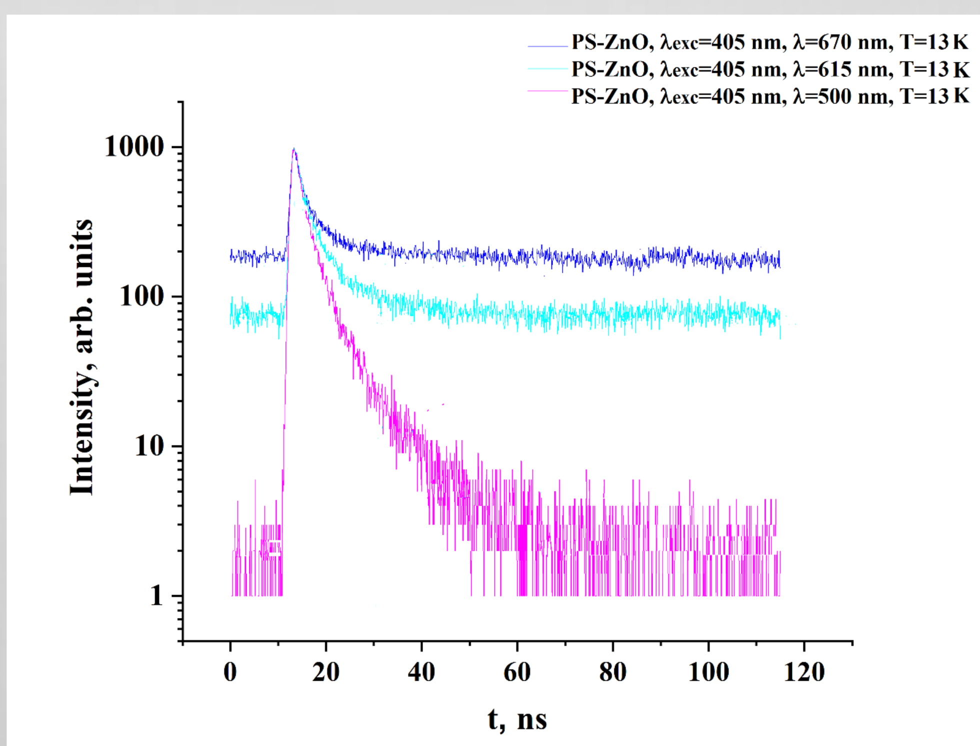

Fig. 11. The decay time curves of the PS-ZnO photoluminescence bands under GaN laser (405 nm) excitation, measured at T = 13 K: a) band with a maximum at 500 nm; b) band with a maximum at 615 nm; c) band with a maximum at 670 nm.

Conclusion.

Nanostructured ZnO material (electrochemical deposition and gas transport reaction method) on the porous silicon surface was obtained.

Images of PS surfaces and PS-ZnO structure were obtained using electron and atomic force microscopy.

PL spectra, PL excitation spectra, the decay time curves of the photoluminescence bands of porous silicon and PS with ZnO deposited on its surface at room and helium temperature were studied.

1. Aksimentyeva O.I., Monastyrskyi L.S., Savchyn B.M // Modec.Cryst.&Liq.Cryst., 2007, Vol.467.- C.73-83.
2. Canham L.T. Appl. Phys. Lett.-1990.-57.- P.1046-1048