

Sensor Properties of The Photovoltaic Structures Poly(3,4-ethylenedioxythiophene) – Porous Silicon

Olenych I.B.¹, Monastyrskii L.S.¹, Aksimentyeva O.I.¹, Yarytska L.I.²

¹Ivan Franko National University of Lviv, Lviv, Ukraine

²Lviv State University of Live Safety, Lviv, Ukraine

The progress in nanoelectronics determines the demand for novel low-dimensional materials, which have specific physical properties due to quantum confinement effect. Recently, hybrid nanosystems on the base of porous silicon (PS) and conductive polymers are in the focus of increased attention. Various electronic and optical systems as well as sensors developed to maximize the use of size effects and large specific surface area of nanoparticles [1-3]. Modification of PS surface by poly(3,4-ethylenedioxythiophene) (PEDOT) may lead to the appearance of new properties or effects that depend on the gas environment and easily recorded. Therefore, the aim of this study was to create hybrid structures of PEDOT-PS-*n*-Si and studying the effect of adsorption of polar gas molecules on their photovoltaic properties.

Thin film PEDOT coatings on PS surfaces were produced by electrochemical polymerization of 0.1 M solution of 3,4-ethylenedioxythiophene in water-ethanol solvent (1:1), with 0.5 M H₂SO₄ used as an electrolyte. Molecular structure of the PEDOT-PS-*n*-Si composite was explored using FTIR spectroscopy. Modification of the PS surface with conjugated polymer PEDOT led to a change in the nature of the measured CVC. It was observed the rectifier CVC and formation of photosensitive electrical barriers in hybrid structure of PEDOT-PS-*n*-Si. It is established that the photovoltage value of hybrid structure depends on the ambient atmosphere. Increased concentrations of NH₃ and H₂O molecules in the air caused decrease in photovoltage. The adsorption of NO₂ molecules caused an increase in photovoltaic signal. The analysis of the concentration dependence of adsorption sensitivity showed that the hybrid sensory structure had the greatest sensitivity to adsorption of molecules of NO₂. Response time of sensory structure PEDOT-PS-*n*-Si on change in the concentration of H₂O molecules does not exceed 70 s, which is small enough for microelectronic sensors of humidity.

1. Misra S., Bhattacharya R., Angelucci R. Integrated polymer thin film macroporous silicon microsystems // *J. Indian Inst. Sci.* – 2001. – V. 81. – P. 563-567.
2. Olenych I.B., Monastyrskii L.S., Aksimentyeva O.I., Sokolovskii B.S. Humidity sensitive structures on the basis of porous silicon // *Ukr. J. Phys.* – 2011. – V. 56. – P. 1198–1202.
3. Monastyrskii L.S., Aksimentyeva O.I., Olenych I.B., Sokolovskii B.S. Photosensitive structures of conjugated polymer – porous silicon // *Mol. Cryst. & Liq. Cryst.* – 2014. – V. 589. – P. 124–131.