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

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

[1]*Ivan Franko National University of Lviv, Lviv, Ukraine*
[2]*Lviv 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-ethylenedioxytiophene) (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-ethylenedioxy-thiophene in water-ethanol solvent (1:1), with 0.5 M H_2SO_4 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 NH_3 and H_2O molecules in the air caused decrease in photovoltage. The adsorption of NO_2 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 NO_2. Response time of sensory structure PEDOT–PS–*n*-Si on change in the concentration of H_2O molecules does not exceed 70 s, which is small enough for microelectronic sensors of humidity.

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