Nanocomposites and nanomaterials

Electrical and photoelectrical properties of reduced graphene oxide - porous silicon nanostructures

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Graphene and graphene-based materials have been attracting great research interest with regard to their outstanding electronic and optical properties which leading to the expansion of its applications in diverse field such as sensors, energy storage devices and photodetectors. In particular, nanocomposites based on reduced graphene oxide (RGO) and light-emitting porous silicon (PS) are promising in optoelectronics and power engineering [1,2].

In this work, the RGO−PS hybrid nanosystems are implemented in order to investigate their electrical and photoelectrical properties. A stable homogeneous suspension of RGO was prepared by the reduction of aqueous dispersion of graphene oxide under action of hydrazine and treatment in an ultrasonic bath. Obtained RGO was infiltrated in sponge-like geometrical structure of PS on bulk silicon substrates. Topology of RGO−PS structure was characterized by atomic-force microscopy (AFM). Electrical parameters were investigated in modes of alternating and direct current. CVCs of RGO–PS sandwich-structures are of rectifying character and were studied using AFM tip which was positioned on RGO surface plate or the ITO contact. Under illumination of the PS surface by white LED, the CVC of RGO–PS nanostructure changes similarly to those observed in a photodiode structure. The photovoltage spectra of our structures measured in the open-circuit regime are characterized by a wide band with maximum in the region of 700–900 nm and similar to the photoresponse spectrum of the industrial silicon photodiode. Electrical and photoelectrical parameters of RGO–PS nanostructures make it possible to use the hybrid material for conversion and storage of energy.

1. *Oakes L., Westover A., Mares J.W., Chatterjee S., Erwin W., Bardhan R., Weiss S.M., Pint C.L.* Surface engineered porous silicon for stable, high performance electrochemical supercapacitors // Sci Reports.-2013.-**3**.-3020.
2. *Olenych I.B., Aksimentyeva O.I., Monastyrskii L.S., Horbenko Yu.Yu., Partyka M.V., Luchechko A.P., Yarytska L.I.* Effect of graphene oxide on the properties of porous silicon // Nanoscale Research Letters.-2016.-**11**.-43.