Fabrication and characterization of ZnO/Graphene layered structures

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Zinc oxide (ZnO) is known as n-type semiconductor and transparent conductive oxide with high exciton binding energy (60 meV), a high dielectric constant and a wide band gap (3.36 eV). ZnO is perspective material for application in gas and biological sensors, which sensing mechanism is based on a change in electrical and optical properties due to the interaction between the sensor surface states and the adsorbed molecules [1, 2]. Graphene - semiconductor with high electrical conductivity, transparency for visible and near-infrared spectrum, mechanical strength and flexibility – can act as an excellent electron acceptor and transport material for effectively migration of photoinduced electrons of ZnO [3]. Thus combination of ZnO with graphene may increase sensitivity, selectivity, reproducibility and response of sensors [4].

ZnO/Graphene layered structures were fabricated on SiO_2/Si substrate by deposition layer by layer. ZnO structures with necessary thickness were deposited by atomic layer deposition method. Monolayer graphene, synthesized by chemical vapor deposition method, was transferred on top of ZnO structures by polymer-based method. Quality of produced ZnO/Graphene layered structures was inspected by Raman spectroscopy, X-ray reflectivity and atomic force microscopy. The influence of graphene to crystallinity of ZnO structures was studied by grazing incidence X-ray diffraction and transmission electron microscopy. Photoluminescence and transmittance spectra were obtained and compared. The combination of ZnO/Graphene in layered structures provides to obtain heterostructures with large surface area, improved crystalline quality, electronic and optical properties, which may find applications in future micro- and nanodevices.

References

1. C. Wang, L. Yin, L. Zhang, D. Xiang, R. Gao, Sensors **10**, 2088-2106 (2010)
2. F. Liu, Y. Zhang, J. Yu, S. Wang, S. Ge, X. Song, Biosensors and Bioelectronics **51**, 413-420 (2014)
3. J. Q. Tian, S. Liu, H.Y. Li, L. Wang, Y.W. Zhang, Y.L. Luo, A. Asiri, A.O. Al-Youbi, X.P. Su, RSC Advances **2**, 1318-1321 (2012)
4. D. Fu, G. Han, Y. Chang, J. Dong, Materials Chemistry and Physics **132**, 673-681 (2012)

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