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Fabrication of heterostructured M@M´Ox Nanorods by low temperature PECVD

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In this communication we report on the fabrication of two different heterostructured 1D materials by low temperature (135 ºC) plasma enhanced chemical deposition: Ag@TiO2 and Ag-NPs@ZnO nanorods (NRs) [1, 2]. The controlled formation of these heterostructures on processable substrates such as Si wafers, fused silica and ITO is demonstrated. The NRs are studied by SEM, HAADF-STEM, TEM, XRD and in situ XPS in order to fully describe their microstructure and inner structure, eventually proposing a growth mechanism. The first type of nanostructures consists on a silver wire surrounded by a TiO2 shell that grows following the volcano-like mechanism [1]. The Ag-NPs@ZnO nanostructures are formed by supported ZnO nanorods decorated with Ag nanoparticles (NPs). The 3D reconstruction by HAADF-STEM electron tomography reveals that the Ag NPs are distributed along the hollow interior of highly porous ZnO NRs. The aligned Ag-NPs@ZnO-NRs grow by a combination of different factors including geometrical distribution of precursor, plasma sheath and differences in the silver/silver oxide densities. Tuning the deposition angle, Ag@ZnO-NRs depicting different tilting angles can be homogeneously grown allowing the formation of zig-zag nanostructures. The as prepared surfaces are superhydrophobic with water contact angles higher than 150º. These surfaces turn into superhydrophilic with water contact angles lower than 10º after irradiation under UV light. In the case of the AgNPs@ZnO NRs such modification can be also provoked by irradiation with VIS light. The evolution rate of the wetting angle and its dependence on the light characteristics are related with the nanostructure and the presence of silver embedded within the NRs.
[1] A. Borras et al. J. Phys. D: Appl. Phys. 44 (2011) 174016.
[2] M. Macias-Montero et al. J. Mater. Chem. 22 (2012) 1341.

Keywords
ZnO
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