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Enhanced photoresponsivity of Au functionalized ZnO nanofibers

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Photodetectors have attracted great attention in various applications such as industrial and environmental monitoring [1]. One-dimensional (1D) ZnO nanostructures due to their wide band gap (˜3.3 eV), large exciton binding energy (60 meV), high effective surface area as well as good charge transport are considered as proper building blocks for fabricating UV photodetectors [2]. Among different methods for synthesizing 1D nanostructures, electrospinning is an efficient and scalable technique which yields a considerable amount of long (μm size) 1D ZnO nanofibers which makes device fabrication more facile. Despite good UV photodetection of 1D ZnO nanostructures, improving their performance parameters such as response and detection range is still a challenge. One of the strategies to reach these goals is incorporation of noble metal (Au, Pt, and Ag) nanoparticles (NPs) into 1D ZnO nanofibers which improves detector properties through surface modifications and Schottky junctions''formation [3]. Moreover, it is believed that size and homogeneity of the noble metal NPs play an important role in the light sensing. Therefore, we have used sputtering technique to deposit Au thin film with different layer thicknesses to optimize functionalization of 1D ZnO nanofibers. To fabricate photodetectors, Au interdigitated electrodes (width: 200 μm and separation: 30 μm) were patterned on SiO2/Si substrates by photolithography process followed by deposition of ZnO nanofibers via electrospinning method. Then, different thicknesses of Au layer in the nanometer range (2-8 nm) were sputtered on the prepared samples, and subsequently they were annealed at 450 ℃ for 30 Min. The samples were characterized using scanning electron microscopy (SEM), photoluminescence (PL) and UV-Visible spectroscopy. Measurement of higher UV photoresponse (Iphoto/Idark) of the Au decorated ZnO nanofibers as compared to the pure ones with maximum value for the sample with 4 nm Au, confirms the effective role of the Au NPs in the sensing mechanism. To achieve a wider spectral response range (UV-Vis-IR), an optimum Au film thickness of 8 nm was determined for the studied ZnO nanofibers. Furthermore, it was also found that Au NPs exhibit localized surface plasmon resonance (LSPR), leading to broaden of photodetection range into visible region.

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