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Highly Responsive p-NiO/n-rGO Heterojunction Based Self-Powered UV Photodetectors

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Abstract : Detection of ultraviolet (UV) radiation is very important as it has exhibited a profound influence on humankind and other existences, including military equipment. In this work, a self-powered UV photodetector was reported based on oxides heterojunctions. The thin films of p-type nickel oxide (NiO) and n-type reduced graphene oxide (rGO) were used for the formation of p-n heterojunction. Low-Cost and low-temperature chemical synthesis was utilized to prepare the oxides, and the spin coating technique was employed to deposit those onto indium doped tin oxide (ITO) coated glass substrates. The top electrode platinum was deposited utilizing physical vapor evaporation technique. NiO offers strong UV absorption with high hole mobility, and rGO prevents the recombination rate by separating electrons out from the photogenerated carriers. Several structural characterizations such as x-ray diffraction, atomic force microscope, scanning electron microscope were used to study the materials crystallinity, microstructures, and surface roughness. On one side, the oxides were found to be polycrystalline in nature, and no secondary phases were present. On the other side, surface roughness was found to be low with no pit holes, which depicts the formation of high-quality oxides thin films. Whereas, x-ray photoelectron spectroscopy was employed to study the chemical compositions and oxidation structures. The electrical characterizations such as current-voltage and current response were also performed on the device to determine the responsivity, detectivity, and external quantum efficiency under dark and UV illumination. This p-n heterojunction device offered faster photoresponse and high on-off ratio under 365 nm UV light illumination of zero bias. The device based on the proposed architecture shows the efficacy of the oxides heterojunction for efficient UV photodetection under zero bias, which opens up a new path towards the development of self-powered photodetector for environment and health monitoring sector.

Keywords : chemical synthesis, oxides, photodetectors, spin coating
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