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Oxide planar p–n heterojunction prepared by low temperature solution growth for UV-photodetector applications

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Abstract

The paper presents the low temperature growth of a planar p-NiO/n-ZnO/FTO heterostructure for efficient detection of soft UV light. n-ZnO was prepared at 60°C using an aqueous bath of zinc nitrate precursor. The 2D layer was uniform and well-covered the FTO substrate. NiO was electrodeposited on top of this layer at 90°C in a dimethyl-sulfoxide (DMSO)-based electrolytic solution. The use of an aprotic solvent is shown to lead to the direct formation of nickel oxide. The p-type conductivity of NiO was demonstrated by the rectifying character of the heterostructure. The p-NiO/n-ZnO planar heterostructured-heterojunction demonstrated UV-photodetection properties with a good sensitivity under forward and reverse bias. A response SUV ≈ 2.46 at −1 V applied bias and a relatively low turn-on voltage of about 0.76 V were measured. The latter is much lower compared to turn-on voltages for other p-NiO/n-ZnO heterostructures reported in the literature. The elaborated method can serve as a new paradigm in simple and low-temperature deposition of type II heterostructures with large area and high separation efficiency for fabrication of high-performance optical devices, as well as for other types of applications such as gas sensors and catalysis.