From nanoparticles, nanorods to nanowalls: preparation and analysis of ZnO using hydrothermal approach for hydrophobic and UV photodetector applications

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Aims and scope

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Abstract

This work investigates the synthesis of ZnO nanostructures with various aspect ratios, such as nanoparticles (NPs), nanorods (NRs), and nanowalls (NWs), by controlling the hexamethylenetetramine (HMT) concentrations via a hydrothermal approach for UV detectors and hydrophobic surfaces. The FE-SEM images revealed that the surface morphology of zinc oxide NPs, NRs, and NWs was well aligned and dispersed throughout the glass substrate. Hexagonal wurtzite ZnO was confirmed using X-ray diffraction (XRD). Apparently, rods and walls where growth well alignment highly reflect the oriented (002) plane onto the glass substrate, as depicted in FE-SEM analysis. Current–time (I–T) measurements verified the photodetector's performance and revealed a significant photocurrent enhancement under 365 nm UV light, reaching 45 μA for the nanorods sample 1:0.5, achieving a 96% sensitivity, the highest of all samples tested. In addition, the vertical alignment of the 1:0.25 ZnO NRs enabled superhydrophobicity, resulting in a 162.40° contact angle. As a result, these findings confirm the value of the hydrothermal route for preparing different shapes of ZnO for advanced applications such as self-cleaning and UV detector.