

**Fabrication, structural, optical, electrical, and humidity sensing characteristics
of hierarchical NiO nanosheet/nanoball-fower-like structure films**

ABSTRACT

In this work, nickel oxide (NiO) nanosheet/nanoball-fower-like structures (NSBS) were directly grown on a NiO seed-coated glass substrate using a low-temperature immersion method at 75 °C. The thickness, or density, of the nanoball-fower-like structures difered based on the following samples order: NSBS1< NSBS2< NSBS3. The synthesised NSBS films were investigated in terms of structural, optical, electrical, and humidity sensing characteristics. The X-ray diffraction (XRD) analysis revealed that the NSBS samples corresponded to the face-centred cubic NiO with fve diffraction patterns indexed to the (111), (200), (220), (311), and (222) planes. The interplanar spacing, lattice parameter, unit cell volume, strain, and stress were also determined from the XRD results. The transmittance spectra showed that the NSBS samples had a transparency of more than 30% in the visible region. The optical bandgap values for the NSBS samples were estimated in the range between 3.72 and 3.75 eV, which is directly related to their lattice expansion and defect characteristics. The current–voltage and Hall efect measurement results revealed that the NSBS2 displayed good electrical properties with the resistance, hole concentration, and hole mobility values of 7.84 MΩ, 8.71×10^{15} hole/cm^{–3}, and 1.88 × 10² cm² /V s, respectively. The NSBS samples performed well for humidity sensing with the highest sensitivity value of 169 being obtained for the NSBS2. These humidity sensing results correlated well with their structural, optical, and electrical characteristics.