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The blue luminescence of p-type NiO nanostructured material induced by defects: H₂S gas sensing characteristics at a relatively low operating temperature

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Abstract

The detection of hazardous and toxic gases in homes and corporate world, with highly sensitive and selective manner continues to be of great interest. Therefore, we report on the gas sensing characteristics of NiO nanostructures with crystallite sizes of approximately 10–17 nm prepared by a co-precipitation method using various reaction times ranging from 2 to 24 h. The physical variation of the colour from green to black after heat treatment was observed due to non-stoichiometric property of NiO revealing blue emission, which was assigned to oxygen and/or nickel vacancies. The diffuse reflectance spectra revealed a wide direct band gap in the range of 3.4–3.6 eV. The high BET surface area ranging from 46 to 84 m²/g was witnessed. The NiO-8 h sensor revealed an excellent response of 74 towards 60 ppm of H₂S at 75 °C in dry air. The detection limit of 0.013 and 1.6 ppm was observed for NiO-8 h based sensor in dry air and RH-40%, respectively. These findings specify that the NiO-8 h sensor has pronounced potential for applications in high-performance H₂S gas sensor operating at low temperature. The underlying mechanism for the improved NiO-8 h sensing performance is debated.