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Fabrication of a propanol gas sensor using p-type nickel oxide nanostructures: The effect of ramping rate towards luminescence and gas sensing characteristics

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Abstract:
We report on the effect of the annealing temperature ramping rate on the gas sensing performance towards n-propanol gas and the luminescence properties using p-type NiO gas sensors prepared by the hydrothermal method and annealed at various ramping rates. The crystallite sizes of NiO nanostructures decreased from 22 to 7.4 nm, while the Brunauer–Emmett–Teller measurements complemented that by showing improvement in surface area from 0.15 to 129.11 m2/g. The blue emission observed from photoluminescence studies was associated with oxygen and/or nickel vacancies. The existence of a non-stoichiometric NiO was thoroughly investigated by x-ray photoelectron spectroscopy. Among the fabricated p-type NiO sensors, the ramping rate of 1 °C/min NiO-based sensor demonstrated excellent sensitivity, rapid response/recovery times and low limit of detection to n-propanol in dry air and relative humidity (RH) conditions. Moreover, NiO-1 oC/min-based sensor showed enhanced and stable response in the existence of various RH and its response remained stable with RH percentage. Such stability to RH changes makes it competitive for practical applications. The sensor further showed a clear stability towards n-propanol after 10 days, proving that it can be considered as a possible contender for the detection of n-propanol gas at relatively low operating temperatures.