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La³⁺ doped ZnO nanofibers obtained through electrospinning: Influence of La³⁺ doping concentration on the structural, optical and gas sensing properties

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ZnO has been used as a gas sensing material for different reducing and oxidizing gases, however; poor sensitivity and slow response and recovery times are hindering its commercial application. Doping of ZnO with different metallic ions such as rare earth and noble metals have proven to be one of the efficient ways of modifying its gas sensing performance. In this study, ZnO nanofibers with different La³⁺ doping concentration (0, 0&#1831, 0&#1833 and 0&#1835 wt.%) were successfully obtained through electrospinning and subsequent annealing at 500 &#176C. The effect of La³⁺ concentration on the structural, morphological, surface area and optical properties were studied using X-ray diffraction (XRD), scanning electron microscopy (SEM), Brunauer Emmett Teller (BET) and Photoluminescence (PL) spectroscopy. XRD results revealed a single phase of hexagonal wurtzite ZnO that showed poor crystallinity, shifted peaks to higher two theta and changes in lattice parameters with La³⁺ doping, confirming the substitution of Zn²⁺ by La³⁺ in the ZnO lattice. Morphological studies revealed fibers structures that were made of tiny particles of 20-40 nm adjoined together and no change in morphology was induced by the La³⁺ doping. BET indicated that the surface area of ZnO was improved by La³⁺ doping. The PL emissions quenched with increasing La³⁺ concentration. Gas sensing performance of these samples to different test gases was performed at different temperatures ranging from room temperature to 400 &#176C at different gas concentrations ranging from 5-100 ppm.

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