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Design of porous p-type LaCoO3 nanofibers with remarkable response and selectivity to ethanol at low operating temperature

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Abstract

This work reports on the fabrication of remarkably selective and sensitive LaCoO3 nanofibers (NFs) based sensors obtained after annealing at different temperatures of 550, 650, and 700 °C. Findings from field emission scanning electron and high resolution transmission electron microscopes demonstrated that the synthesized LaCoO3 NFs consisted of a number of interconnected particles with average sizes of ~ 47, 58 and 77 nm, for 550, 650, and 700 °C annealing temperatures, respectively. Systematic gas sensing analysis revealed that the sensors based on LaCoO3 NFs have substantial sensitivity to 40 ppm ethanol gas with the sensor obtained at 650 °C revealing an outstanding response of 32.4 at a lower optimum operating temperature of 120 °C. While it exhibited good selectivity to ethanol gas as well as fast response and recovery speeds of 26 and 66 s, respectively. The enhanced sensing capability of the LaCoO3 NFs based sensor at 650 °C stems from combined effects of the interparticle nanofibrous structure, which provided high surface and porous channels. These allowed access to active sites as well as ease of gas diffusion and overlapping of the hole accumulation layers along the fiber direction producing a continuous hole transfer channels. The detailed ethanol sensing mechanism of these NFs is also discussed.