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Production of hazardous gas sensors using spinel ferrite nanoparticles

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This work reports on sensitive and selective gas sensors based on copper ferrite (CuFe2O4) nanoparticles. The nanoparticles were produced different methods including: colloid microwave assisted hydrothermal method, and co-precipitation method. Those methods enable a precise control of nanoparticle size, The produced nanoparticles were annealed at different temperatures. Structural analysis were carried out using x-ray diffraction (XRD) and transmission electron microscopy (TEM), and they revealed that the as-prepared nanoparticle exhibit cubic structure. The nanoparticles undergo crystal structure transformation to tetragonal structure upon annealing. Furthermore, the nanoparticle were found to grow in size upon annealing. The tetrahedral and octahedral absorption bands which are characteristic of the spinel ferrite were determined using Fourier Transform Infra-Red Spectroscopy (FTIR) measurements. Gas sensors were fabricate by pressing the produced nanoparticle powder into disks. The sensor device was produced utilizing capacitor structure, with the top electrode stainless steel of grid structure. The produced sensors were characterized to be sensitive to both H2S and H2 gases, with greater sensitivity to H2S at low temperatures, where these sensors could detect H2S concentrations of 10 ppm at 80 °C. The low optimal operation temperature reveals the low power requirements for sensor operation. Thus, those sensors exhibit the potential to be used for industrial applications, especially for the petrochemical industry the Petroleum Institute under a grant number RIFP-14312 and Qatar University.

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