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Structural and gas sensing properties of greigite (Fe_3S_4) and pyrrhotite ($Fe_{1-x}S$) nanoparticles

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ABSTRACT:

Iron sulfide nanoparticles Fe_3S_4 and $Fe_{1-x}S$ were synthesized via solvothermal decomposition of piperidine iron(III) dithiocarbamate complex in oleylamine. At a reaction temperature of 230 degrees C, the cubic Fe_3S_4 phase (greigite) was obtained whereas at 300 degrees C, monoclinic $Fe_{1-x}S$ (pyrrhotite) was obtained. In both cases, hexagonal sheet like structures with sizes ranging from 50 to 200 nm were obtained. Powder X-ray diffraction studies reveal that the temperature plays a significant role in determining the crystalline structure and chemical composition of the as-synthesized nanoparticles (NPs). Gas sensing applications further reveal activities which are phase-dependent. The greigite has a higher response to humidity but saturates faster than the pyrrhotite. The pyrrhotite phase however outwits the greigite on response to H_2, NO_2, NH_3 and CH_4. In these gases, the greigite displays early saturation as well as noisy and uncoordinated signals.