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Simultaneous substitution of Ba, Mn and Co into Fe_3O_4 spinel structure: Magnetic and electrochemical sensing properties of the synthesized nanoparticles

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Abstract content
 (Max 300 words)
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Special chars

Simultaneous substitution of Ba, Mn and Co was successfully achieved by glycol thermal route. The phase formation was confirmed by X-ray powder diffraction technique. The microstrain is investigated based on the Williamson-Hall plot. Crystallinity, shape and size of the nanoparticles were investigated by high resolution transmission electron microscopy and high resolution scanning electron microscopy. Brunauer-Emmet-Teller measurements revealed that the sample has high surface area of $116 \text{ m}^2/\text{g}$. The sample displays mesoporous character based on the Barrett-Joyner-Halenda test. The magnetic properties as a function of temperature were performed on mini-cryogen free VTI system in the temperature range 4 K to 300 K. The magnetization increased from $66.5 \pm 0.3 \text{ emu/g}$ to $84.4 \pm 0.5 \text{ emu/g}$ from 300 K to 4 K respectively. The sample was found to become magnetically harder at low temperature since the coercivity increases from $0.009 \pm 0.003 \text{ T}$ to $1.01 \pm 0.004 \text{ T}$ for the temperatures 300 K and 4 K respectively. The temperature dependence of the coercive field followed Kneller's law, whilst a modified Bloch's law was suitable in describing the magnetization as a function of measuring temperature. The electrochemical properties of $\text{Ba}_{1/3}\text{Mn}_{1/3}\text{Co}_{1/3}\text{Fe}_2\text{O}_4$ nanoparticles were also investigated. Cyclic voltammograms of ferricyanide oxidation showed that the synthesized nanoparticles modified electrode exhibited improved electrochemical activity as compared to the bare electrode. These high-performance electrodes are expected to lead to the development of a novel group of electrochemical sensors.

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PhD

Main supervisor (name and email)
 and his / her institution

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