Contribution ID: **188** Type: **Oral Presentation**

Simultaneous substitution of Ba, Mn and Co into Fe₃O₄ spinel structure: Magnetic and electrochemical sensing properties of the synthesized nanoparticles

Wednesday, 1 July 2015 14:00 (20 minutes)

Abstract content
   (Max 300 words)
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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 m^2/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 ± 0.3 emu/g to 84.4 ± 0.5 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 ± 0.003 T to 1.01 ± 0.004 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 Ba_{1/3}Mn_{1/3}Co_{1/3}Fe₂O<sub> 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

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Session Classification: DPCMM

Track Classification: Track A - Division for Physics of Condensed Matter and Materials