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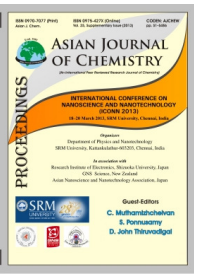

Synthesis and Characterization of Strontium Ferrite Nano Powder†

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Strontium ferrite powder was successfully synthesized in both water and ethylene glycol media by co-precipitate method. The phase formation is confirmed by XRD analysis. The functional groups were identified by FTIR and the surface morphology was found by SEM. The magnetic properties were determined by vibrating sample magnetometer. From the above results, it is inferred that the use of ethylene glycol as a solvent instead of water solvent has reduced the size of the crystalline powder.

Key Words: Nanoparticles, Vibrating sample magnetometer, XRD.

INTRODUCTION

Several studies on the synthesis of strontium ferrite ($SrFe_2O_4$) particles have been performed because of the diversified industrial applications of the material[1-3]. In the literature, chemical routes are presented as the most commonly used methods for synthesizing strontium ferrite ($SrFe_2O_4$)[4]. Precipitation process makes possible the production of large quantities of strontium nitrate and ferric nitrate in a reproducible way. Nevertheless, intermediate compounds, depending on the strontium nitrate and ferric nitrate salt, are usually precipitated and then transformed into strontium ferrite by precipitation process.

The goal of our work is to synthesize strontium ferrite ($SrFe_2O_4$) nano particles at room temperature and we preferred chemical route method in which strontium nitrate and ferric nitrate particles were allowed to precipitate directly at room temperature.

EXPERIMENTAL

About 2.1163 g of strontium nitrate and 4.04 g of ferric nitrate were taken in 40 mL double distilled water. The solution was stirred by a magnetic stirrer for about 2 h. The ammonium hydroxide solution was added drop by drop to get the strontium ferrite precipitate at room temperature by adjusting the pH value of the solution.

The removal of an impurities in the product was done by washing the precipitate several times by distilled water and ethanol. The strontium ferrite precipitate was then dried in air hot oven and the product strontium ferrite pre-cursor was obtained.

The precursor was calcined at around 800 ºC for *ca.* 3 h in the furnace.

The reaction involved in the synthesis process is as below

$$Sr(NO_3)_2 + 2Fe(NO_3)\cdot 9H_2O + H_2O + NH_4OH \rightarrow SrFe_2O_4 + 8HNO_3 + 14H_2O + NH_4OH$$

RESULTS AND DISCUSSION

Powder X-ray diffraction analysis: Fig. 1 represents the XRD pattern of strontium ferrite prepared in the medium of water and calcined at 800 ºC for 3 h. The XRD analysis confirms that the crystalline structure of Strontium ferrite powder. The peaks match well with the standard reported values. The JCPDS file number to which the XRD data match is (48-0156).

FT-IR analysis: The FT-IR pattern of strontium ferrite precursor crystalline powder is shown in Fig. 2. The functional groups are identified from the FT-IR analysis of precursor. The peak corresponding to 614 cm^{-1} shows metal oxide vibrations. The peak at wave number 3650 cm^{-1} shows O-H stretching of water. The peak at 1384 cm^{-1} corresponds to NO_2 vibrations and that at 1621 cm^{-1} corresponds to the bending vibration of water (Table-1).

Scanning electron microscope: Fig. 3 represent the SEM images of strontium ferrite calcined at 800 ºC for 3 h prepared in water and ethylene glycol media, respectively. From the

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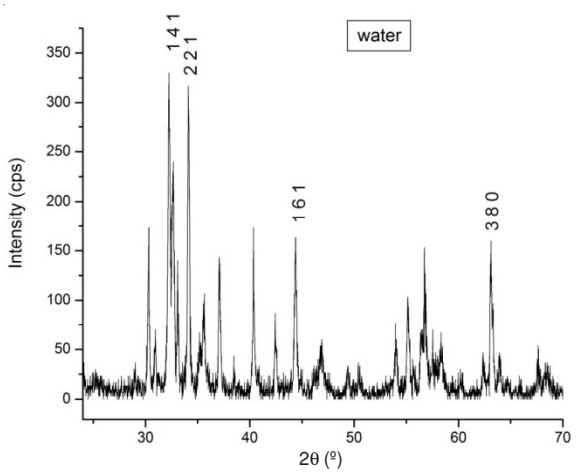

Fig. 1. Powder X-ray analysis of strontium ferrite nanoparticles

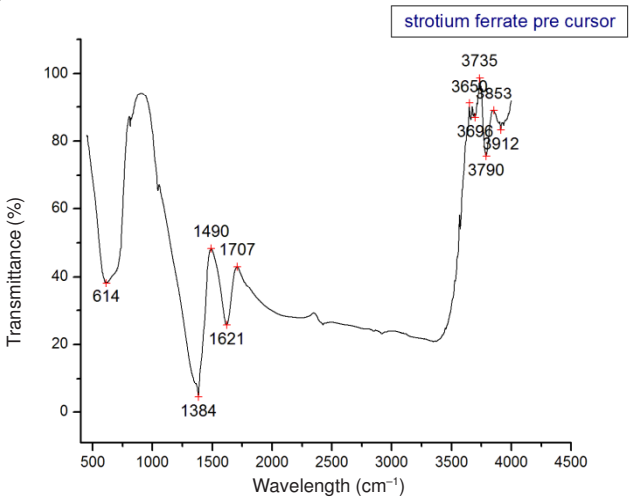

Fig. 2. FT-IR analysis of strontium ferrite nanoparticles

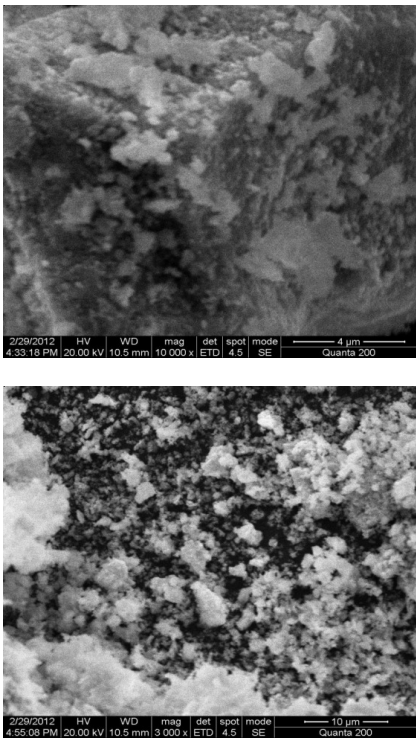

Fig. 3. SEM images of strontium ferrite nanoparticles

TABLE-1

S. No.	Wave number (cm^{-1})	Functional groups
1	614	Metal oxide vibrations
2	1384	NO_2 vibration
3	1621	Bending vibration of water
4	3650	O-H stretching vibration of water

surface morphology of both the cases, it is observed that the particles appear to be almost spherical. But there is a reduction in the size of the particle when the water medium was replaced by ethylene glycol medium.

Vibrating sample magnetometer analysis: To study the magnetic properties of prepared product, the magnetic studies using vibrating sample magnetometer have been made. Fig. 4 represents the hysteresis curve of strontium ferrite crystal prepared in water medium. MS: 20.382 emu/g, Mr: 11.076 emu/g, Hc: 5923.5 gauss, MS: 15.471 emu/g, Mr: 8.0914 emu/g, Hc: 5530.8 gauss.

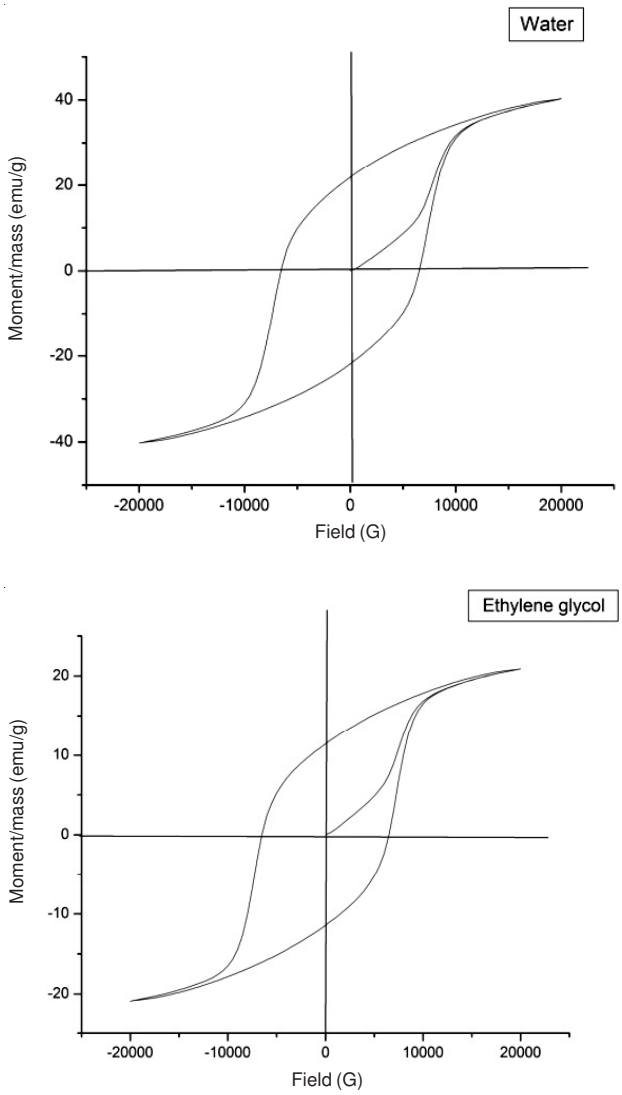

Fig. 4. Hysteresis curve of strontium ferrite crystal in water and ethylene glycol medium medium

Fig. 4 show the values of the saturation magnetization, Ms, the remanent magnetization, Mr and the coercivity Hc of the strontium ferrite crystalline powder prepared in water

medium and represents the hysteresis curve of strontium ferrite crystal prepared in ethylene glycol medium.

Usually when the coercivity increases the particlesizeis reduced. Comparing to the VSM results of strontium ferrite prepared in water medium with the strontium ferrite prepared in ethylene glycol medium it is observed that the coercivity value in ethylene glycol medium (H_c = 5530.8 gauss) is more than that in water medium (Hc = 5923.5 gauss) . It shows that the ethylene glycol solvent served as size reducing agent. Also the high value of Hc shows that the SrFe Product exhibited hard magnetic properties.

Conclusion

Strontium ferrite powder was successfully synthesized in both water and ethylene glycol media by co-precpitate method. The phase formation is confirmed by XRD. The functional groups were identified by FTIR and the surface morphology was found by SEM. The magnetic properties (Ms, Mr and Hc) were determined by VSM. From the above results , it is inferred that the use of ethylene glycol as a solvent instead of water solvent has reduced the size of the crystalline powder.

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