

Magnetic, Optical And Thermal Studies of Ppy/Bafetio Nanocomposite

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ABSTRACT: This paper presents investigations on magnetic, optical and thermal properties of Ti doped barium ferrite substituted PPY nanocomposite prepared by impregnation technique.

I. INTRODUCTION

The Authors already reported the characterization data of XRD, SEM, EDS and FTIR . Also TEM and SAED results has been reported [2]. Our studies established to be the first in the literature by the Sci - find software. Results proved that the successful incorporation of Ti- doped barium ferrite ($x=0.33$ and 0.37) nanopowders in Polypyrrole nanocomposite. In the present paper we have discussed the magnetic, optical and thermal properties of PPY/ BaFe_{11.67}Ti_{0.33}O₁₉ (sample 1) and PPY/ BaFe_{11.63}Ti_{0.37}O₁₉ (sample 2) Experimental method By using impregnation technique nanocomposite of polypyrrole (PPY) doped BaFe_{12-x}Ti_xO₁₉ nanoferrite with two different 'x' values ($x=0.33$ and $x=0.37$) has been prepared. Here synthesis has taken place in two stages. In stage 1 we have prepared Ti doped barium ferrite detailed flow chart of which is given in our earlier communication[1] and detailed explanation of stage 2 preparation is given in our article [2].

II. RESULTS AND DISCUSSION

Vibration Sample Magnetometry(vsm) studies of samples was done using (Lakeshore VSM 7410) SET UP at SAIF of Indian Institute of Technology, Chennai. The optical absorption spectra of the samples were recorded at room temperature using a Shimadzu spectrometer (model UV-3100) in the wavelength range 400-800 nm at CNST, JNTU, Hyderabad. Thermal studies(TG/DTA) of the samples were obtained at 'SAIF', Cochin, Tamilnadu, India on a Perkin Elmer, (Model: Diamond TG/DTA).
 Vibration Sample Magnetometry

A comparative measurements of room temperature field-dependent magnetic properties of sample 1 and 2 are shown in fig 1. Magnetic parameters such as coercivity (H_c), saturation magnetization (M_s), remanent magnetization (M_r) are listed in Table 1.

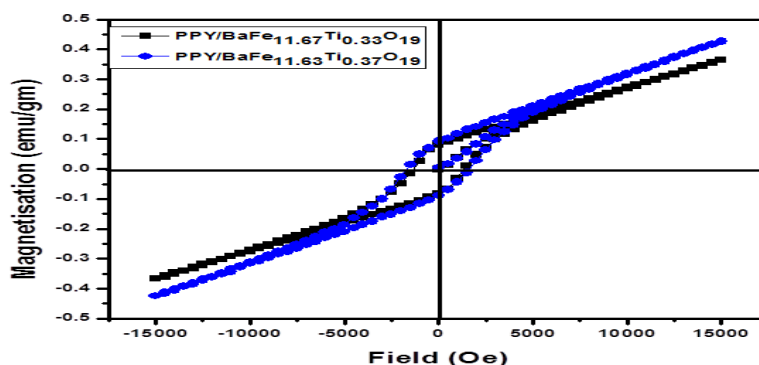


Figure 1 Hysteresis loop of sample 1 and sample 2

S.no	sample	concentration	Coercivity	Retentivity [M_r] emu/gm	Magnetisation [M_s] emu/gm	M_r/M_s	$K \times 10^4$ Ergs/cm ³	$N_b \times 10^2$	Avg. crystallite size
1	BaFe _{11.67} Ti _{0.33} O ₁₉ -3% PPY	($x=0.33$ @ 950°C)	1345.3	0.08133	0.36571	0.22238	262.03	0.0766	11.91

2	BaFe _{11.63} Ti _{0.37} O ₁₉ PPY -3%	(x=0.37@ 950 C)	1668.9	0.09067	0.42577	0.2129	425.7	0.0901 0	13.168
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Table 1: magnetic parameters of sample 1 and sample 2

It is well-known that the surface chemistry greatly affects the magnetic properties of fine magnetic particles due to their relatively larger surface area[3] and Sample 2 has higher saturation magnetization (*MS*), remanent magnetization (*MR*), anisotropy constant (*K*), Magnetic moment (*n_b*), coercivity (*HC*) and crystallite size than sample 1. Reason for this may be due to doping concentration. Lower Squareness ratio indicate Multi-Domain formation. Both samples show discrete absence of Paramagnetic nature. Saturated magnetisation is not reached in any of the samples .

Uv-Visible Spectrophotometer

The optical absorption spectra of the present samples were recorded at room temperature using a Shimadzu spectrometer (model UV-3100) in the wavelength range 400-800 nm at CNST, JNTU, Hyderabad.

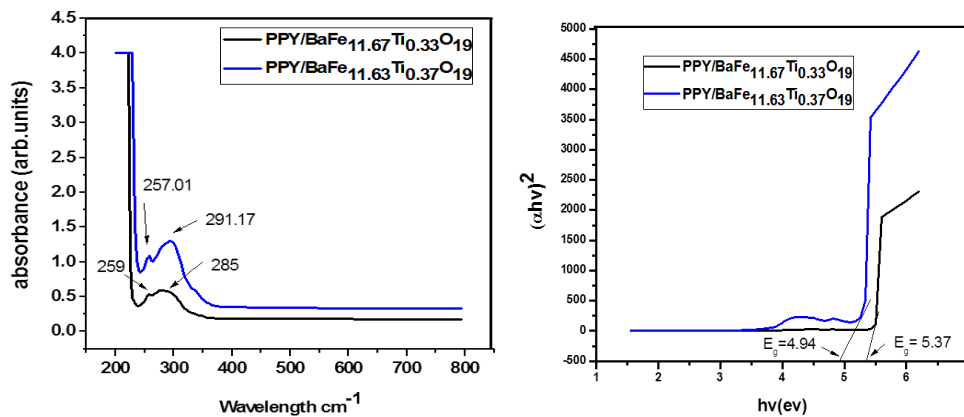


Fig. 2 uv-vis spectra of sample1 and sample 2(a) Wavelength versus absorbance and (b) $h\nu$ versus $(\alpha h\nu)^2$

This experiment determines the band gap of semi-conducting materials found in the nano ferrites composites. Two absorption peaks are observed in both the samples. One peak around ~250 nm due to LCMT (ligand to metal charge transfer) transition and the other at ~290 nm due to PPY. The presence of these peaks in both nano composite samples confirms the formation of PPY/BaFeTiO₁₉ nanocomposites.

The Band Gap values calculated from Tauc plots for Nano composites. The value of band gap for pure barium hexaferrite is in the range of reported literature value of 3.79 [4]. The graph shows that with substitution the band gap increases. The increase in the band gap value is attributed to the quantum confinement phenomenon taking place at the nano-regime. Quantum confinement at nanoscale plays important role in increasing the band gap.

Thermo Gravimetric and Differential Thermal Analysis (TG/DTA)

As prepared samples are studied in SAIF, Cochin, using Perkin Elmer Diamond TG-DTA.

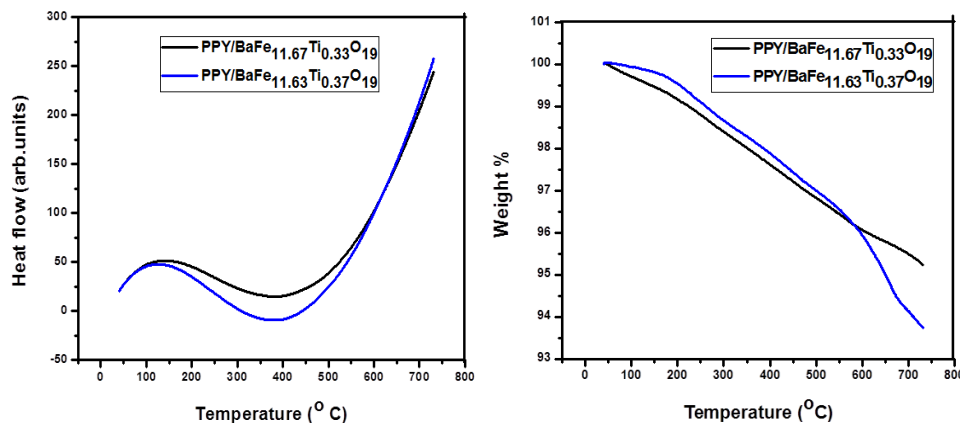


Figure 3(a) and **figure 3(b)** TG/DTA of sample 1 and sample 2

Thermogravimetric studies (presented as plots of temp versus weight loss%) are straight lines with almost zero variation in slope, to conclude convincing thermal equilibrium for temperature of 400⁰C (synthesis of Nanocomposite). Differential thermal analysis plots between temp Vs rate of flow of heat exhibit vivid the endothermic and exothermic peaks. Also corresponding to endothermic peak is confirmed to be 400⁰C.

III. CONCLUSION

Ti doped barium ferrite has been successfully impregnated into polymer PPY. Characterisation of the same has been done by using standard techniques such as VSM, UV-VIS spectroscopy and TG/DTA. Hysteresis loop studies was done using VSM. Band gap of the two samples was determined using UV-VIS spectroscopy. Thermal studies was done using TG/DTA. Both the samples show approximately the same thermal stability.

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