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Incorporation of $BaFe_{(12-x)}Ti_xO_{19}$ into conducting polymer and their characterisation study

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Abstract: *This paper presents incorporation of $BaFe_{(12-x)}Ti_xO_{19}$(for x = 0.35 at three different temperature) nanomaterial into conducting polymer polypyrrole through impregnation technique. As prepared samples are investigated using EDS,TEM,histograms and SAED characterization techniques.*

I. Introduction

As the development of new technologies for radar and microwave communication, the research on microwave absorbing materials has increased in recent years.The main applications of these materials intend to reduce the human exposure to microwaves by means of absorbing coatings.A suitable coating material must be used to protect the functioning of the device from beingtampered by microwave. PPY/$BaFe_{12-x}Ti_xO_{19}$ nanomaterial has been chosen in this research work as a coating material.

The Authors already reported the characterization data of XRD, SEM and FTIR of these materials [1]. Our studies established to be the first in the literature by the Sci – finder software. Results proved that the successful incorporation of Ti- doped barium ferrite ($BaFe_{11.65}Ti_{0.35}O_{19}$) nanopowders in Polypyrole nanocomposite. In the present paper we have discussed the EDS,TEM,histograms and SAED characteristics.

II. Experimental method

There are two stages of sample preparation. In first stage, Ti doped barium ferrite was prepared by Sol-Gel method,detailed flow chart of the method is already reported[2].In second stage, Ti doped barium ferrite(synthesised in first stage) is incorporated into polypyrrole(PPY) through impregnation technique.

Starting materials ($BaFe_{(12-x)}Ti_xO_{19}$, PPY) was weighed proportionately and mixed thoroughly. Mixture was taken into a beaker and mixed in 20ml of Methanol. Then the mixture was subjected to sonification for uniform dispersion. As obtained mixture was stirred at the temperature of 40^0c for two hours. The obtained Powder was dried at room temperature for 24 hrs. Nano ferrite composite powder was obtained. Final products are PPY/$BaFe_{11.65}Ti_{0.35}O_{19}$ (at 850^0C, 900^0C and 950^0C) that is sample 1,sample 2 and sample 3 respectively.

III. Results And Discussion

EDX (Energy dispersive x-ray analysis)

The Edxspectra of all samples gives a confirmation of the chemical composition present in the BaFeTi/PPY composites.

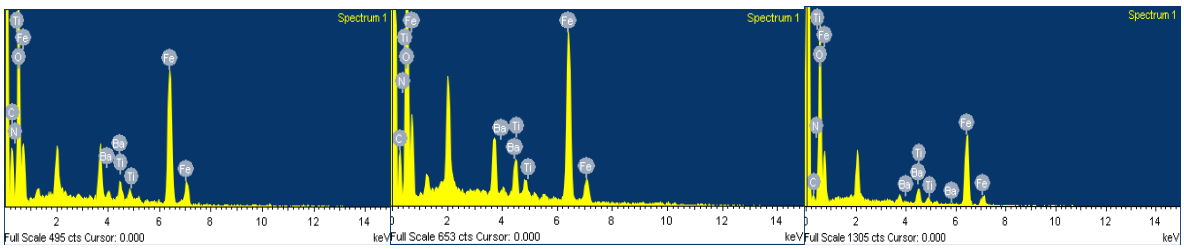

Figure 1: Edax plots of sample1,sample2 and sample3

Peak height of titanium ion is more in sample2 indicating more number of Ti ion are available at higher energy in the B-site of the spinel. So this particular sample has the moreability to absorb electromagnetic radiation of matching energy than sample1 and sample3. Basically barium ferrite has tetrahedral structure.Edaxclearly indicates the presence of Ti ions in both 'A' as well as in 'B' sublattice in all three

samples indicating that the tetrahedral structure is retained during composite formation. Also Ti ions present in higher and lower energy levels confirms that A-O-B spinel sub-lattice formation.

TEM(Transmission electron microscope)

TEM and SAED were done on Nanocomposite samples to know the dispersion of PPY with $BaFe_{12-x}Ti_xO_{19}$.

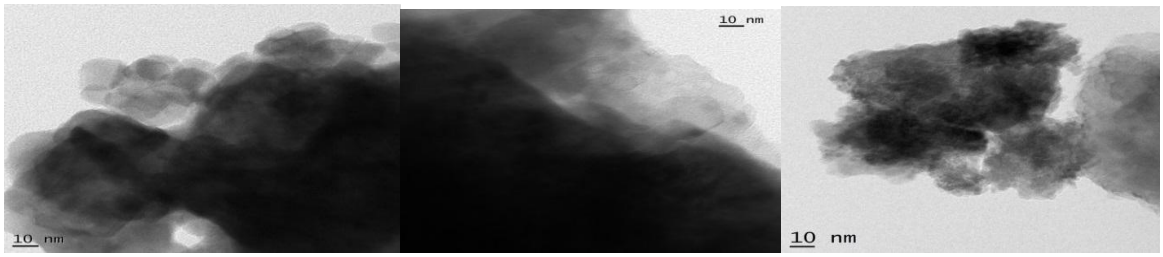

Figure 2: TEM micrograms of sample1,sample2 and sample3

In TEM images of PPY/$BaFe_{12-x}Ti_xO_{19}$ for all sampes, $BaFe_{12-x}Ti_xO_{19}$ particles are surrounded by PPY confirming the coating of the former by later.In micrograph polymer grains are white in colour and ferrite grains are black in colour Since ferrite is magnetic in nature, it absorbs more electrons.This clearly indicates the formation of core-shell structure with doped ferrite as core and PPY as shell.It is observed that PPY was coated on $BaFe_{12-x}Ti_xO_{19}$. But for some samples the coating shell obstructed the contact between the rest of PPY and $BaFe_{12-x}Ti_xO_{19}$ .Rest of PPY assembled as oxidant.

HISTOGRAMS

In order to analyse data histograms are plotted and also Gaussian distribution curve is superimposed on it.

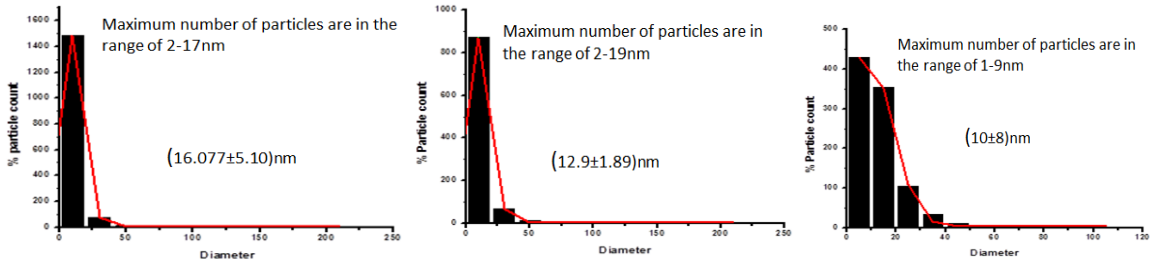

Figure 3: Histograms of sample1,sample2 and sample3

Histograms are drawn by using image jj software either on SEM and TEM images. This gives number of particles distributed size wise. The particle diameter data calculated using image jj software registered a vivid contrast with similar data from XRD[1]. In general majority of the values of the crystallite parameter D showed reasonably good concurrent with the corresponding parameter of XRD calculations with large values of beta in Debye-Scherer equation. The data in (a) TEM and EDX as well as (b) Debye –Scherrer equation from XRD[1] show reasonably good agreement .

SAED(Selected Area Electron Diffraction)

The SAED pattern of $BaFe_{12-x}Ti_xO_{19}$/PPY shows distinct dotted ring pattern that confirms Polycrystalline nature of samples.

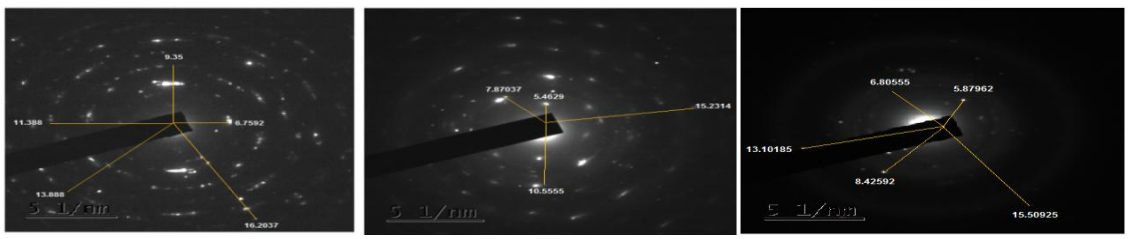

Figure 4: SAED of sample1,sample2 and sample3

Selected area diffraction enables to determine the crystal structure of individual nanomaterials and the crystal structure of the different parts of a sample. Bright spot indicates crystalline structure and rings are formed when an atom in a crystal are systematically arranged in different miller plane. Sample1 and 2 indicate formation of polynanocrystalline structure clearly.

IV. Conclusion

In summary, we have successfully Incorporated nanocomposite into ferrite for all three samples by using impregnation technique.We tried to get jcpds number in order to compare this data, but through Sci-finder we could establish that there are no earlier literature report for this composite sample.All our characterisation establish the formation of nanoferrite and also nanocomposite of core-shell model in our studies.Our reports are the first according to Sci-finder analysis in synthesised composite sample

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