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MAGNETIC PROPERTIES OF SnO_2ZnO NANO COMPOSITES

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Abstract: The magnetic properties of SnO_2ZnONano Composites nano particles of metal oxidesare studied here. The subjected nano composites nano particles of metal oxides were synthesized using chemical route method i.e. microwave assisted chemical co-precipitation technique. For the purpose of determining the magnetic characteristics of the samples that were produced, X-Ray Diffraction, FTIR Spectroscopy, UV-VIS NIR Spectroscopy, and vibrating sample magnetometer XRD (VSM) were some of the techniques that were used to characterise the samples. According to the findings, the samples are likely nanoscale and magnetic in their fundamental make-up. The hysteresis curves of the samples results were analysed and retentivity, coercivity and hysteresisloss of the samples were compared. The comparative study suggests the applications of the samples as per their properties of magnetic behaviour.

Keywords: Magnetic, nano-materials, nano-composites, Vibrating Sample Magnetometer

1. INTRODUCTION

The nano-composites materials are the subject of interest and complete study since long before. Because of its present senerio and potential utilitarian advanced applications, heterogeneous systems made of nanoparticles have been the focus area/field. The large values of the surface-to-volume ratio (s/v) and the total interfacial area of the produced nanoparticles indicate that they are fundamentally connected. In addition, both the nanoparticle and the hosting material may contribute fascinating multi functionalities that accumulate with increasing particle size[1].

In the thrust area, magnetic nanoparticles are a widely used functional nano filler [2, 3]. The degree of dispersion or aggregation of nanoparticles, the intensity of inter-particle interactions, and the influence of the surface on the nanoparticles' magnetism are only a few examples of the elements that might change or restrict the magnetic behaviour of the resulting nano-composites [4,5]. The degree to which the interface between magnetic metal oxide nanoparticles and the provided further effect on their properties[6-12] is still unclear, for example.

Despite the fact that the basic concept of nano-magnetism has been proven in large-scale applications [13–14], a general prophecy of the magnetic characteristics of a particular nano-composites or a family of nano-composites is still not obvious.

This is because the interpretation of data on the magnetic characteristics of nano-composites is complicated by a number of aspects that are not yet fully understood [15, 16].

2. RESEARCH METHODOLOGY

Experimental Synthesis Techniques:-All the chemical used in present study are analytical grade (AR-grade) and not purified at laboratory scale. The $SnCl_2.5H_2O$ and $Zn(No_3)_2.XH_2O$are initial salts were dissolved in doubly distilled water. The ammonia solution was added drop wise as a precipitation agent unless or until the P_H of solution reaches to 9.0 and same was recorded by digital P_H meter. The resulted precipitates were kept for stabilization or aging process for 24 hours at room temperature. There after the precipitates solution were filtered and multiple washed with ethanol and doubly distilled water. The washed cake have been treated to micro wave at 100 degree calcius(100ºC) for 15 minutes 2 sitting and finally calcined at different temperature 200ºC, 400ºC&600ºC for fixed duration 2 hours to form the fine powder samples.
Several methods were used to characterize the samples in terms of their magnetic characteristics.
Sample Characterization: The various techniques were employed to examine morphology & magnetic properties of calcinated samples the X- ray diffraction method Pw-17/10 with nickel filter having Cu Kr- 1.5418A^Oat 50 KV/40MA condition were applied during study and data were recorded as$2\theta\sim10^o$-80^o . The IR-spectrum were examined by Perkin Elmer 1600º and ranging of recorded rats 400-4000cm. The IR spectrum tell us about present in given sample
Vibrating Sample Magnetometer for Magnetic measurement, M vs H (±1.5 T) was used for the magnetic characterization for the field strength of ±1.5 T. The system used is capable to study magnetic characterization of nano-composites, thin films, multi-layer and hetero-structure materials. Hall voltage, resistance, magneto resistance, and I-V characteristics may all be measured and shown by the system, Hall coefficient, carrier concentration and mobility of the given samples. The magnetic field strength ranging inbetween±1.5Twith5mmvariablemagneticairgap, magnetic field resolution is about 0001Oe and magnetic field homogeneity is about + 0. 1 % with over centered 50.8mm diameter circle uniform working area. Micro Sense Easy VSM software version 9.13Wa is used for the data acquisition and analysis.

3. RESULTS AND DISCUSSION

The Philips X ray diffractometer is employed to examine the nature of sample and a most sentence were taken for calcination of crystallite size of all samples by using Debye- scherrer equation. The XRD results were shown in graphically representation in figure 1 . The results of study shows that the Zn++ ion were in corporate at the site of Sn++ ion and not altered the original nature tetragonal structure of SnO2 crystal.

4.2Fourier Transform Infrared (FTIR) Study: FTIR spectra of the SnO_2-ZnO. NCS were calcined at different calcination temperatures 200 0 ºC, 400 0 ºC and 600 0 ºC for 2 hours, which are shown in Figure 5.2. Perusal of the figure shows the IR broad peaks at around 3400 cm-1,1600 cm-1, 607 cm-1 and 680 cm-1. A broad band between 3600 cm-1-3330 cm-1 and broadband between 1700 cm-1 -1400 cm-1 have been at tributed to stretching mode of -OH group,peaksat607 cm-1 and 680 cm-1wereattributed to different vibration modes of Sn-O-Sn and Ni-O. At temperatures 200ºC, 400ºC, and 600ºC peaks represents formation of both Sn-O-Snand Ni- O but at temperature 600ºC peaks are high intense because of increases of lattice. The transmittance increases with increase in the calcination temperatures at fixed duration of heating 2 hours, It might be due to the increase of the condensation of the oxygen during heating process

4.3 Magnetic Properties:- VSM, the magnetic property of nano-composites SnO_2-ZnO was analyzed using a VSM at room temperature. Magnetic hysteres is loop of the calcined samples are shown in Figure 5.3. It is clear from the results that the calcined nano-composites show as of t and ferromagnetic behavior. It is clear from the magnetic hysteresis loop that the coercive force decreases with increase of temperature of ZnO in SnO_2 nano-composites and the retentivity also shows decrement with the increased temperature. Furthermore coercive force decreases in very small amount with increase of temperature of ZnO in SnO_2 nano-composites.

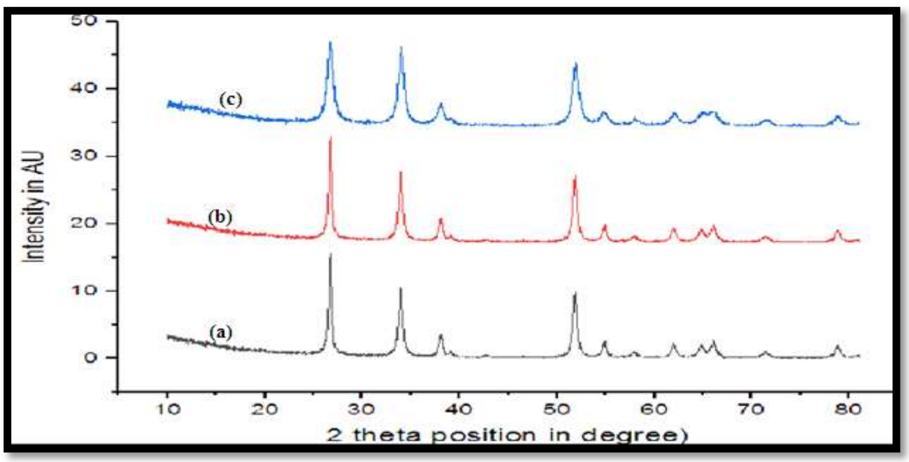

FIGURE 3 SNO2-ZNO 10% NCS CALCINED FOR FIXED DURATION 2 HOURS AT (A) 200 OC (B) 400 OC

(C) 600^{O}

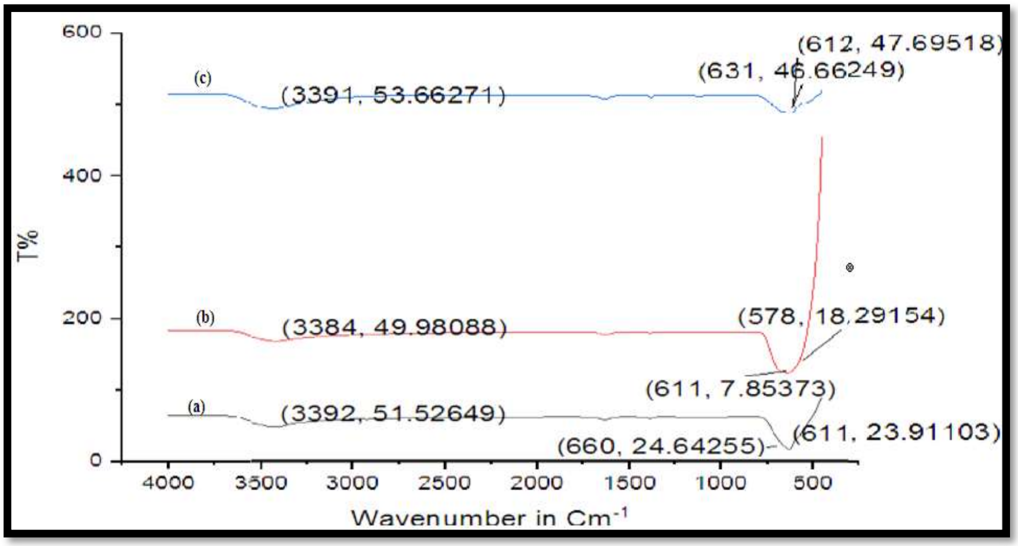

Figure 4: FTIR Spectra of SnO_2-ZnO 10% nano-particles calcined for fixed duration of 2 hrs at calcination temperatures (a)200°C (b)400°C (c)600°C.

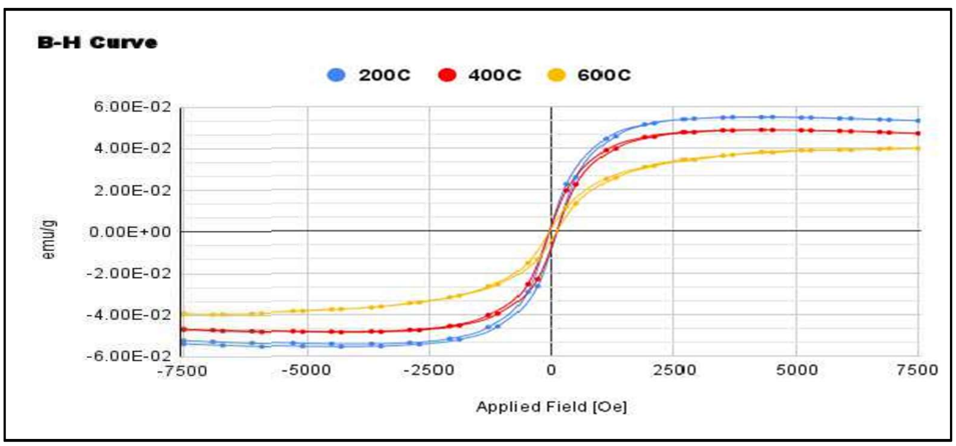

FIGURE 5 HYSTERESIS LOOP OF SnO_2-ZNO 10% NANO-PARTICLES CALCINED FOR FIXED

Duration of 2hours at calcination temperatures (a)200°C(b)400°C(c)600°C.

Conclusion:-The experimental and calculated peaks x-ray diffraction results are well matched and signifies the formation of nano-composites. The figure5.1 shows the comparative study of

Nickel oxide nano-composites. The FTIR results shows that the transmittance increases with

increase in the calcination temperatures at fixed duration of heating 2 hours, It might be due to the increase of the condensation of the oxygen during heating process. It is clear from the magnetic hysteresis loop that the coercive force decreases with increase of temperature of ZnO in SnO_2 nano-composites and there tentivity also shows decrement with the increased temperature. Furthermore coercive force decreases in very very small amount with increase of temperature of ZnO in SnO2 nano-composites.

7. ACKNOWLEDGEMENTS

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