Structural, Optical studies of Pure and Sn doped Lanthanum oxide nano particles

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Abstract **- Pure and Sn doped Lanthanum oxide nanoparticles were synthesized using sol-gel technique. The average crystallite sizes of pure and Sn doped lanthanum oxide is found to be 26 nm. The powder X-ray diffraction studies shows that all samples have single phase hexagonal structure. The Fourier Transform-Infrared Spectroscopy (FT-IR) study fairly agrees with the powder XRD results. From Scanning Electron Microscope (SEM) images, it is clearly seen that a uniform smooth surfaced hexagonal with high porosity structures. The UV-vis Diffuse Reflectance Spectroscopy study confirms the absorption edge shift towards the lower wavelength region with the increase in Sn-concentration in Lanthanum oxide. The Photoluminescence (PL) spectroscopy study indicates the maximum emissive power for Sn doped lanthanum oxide at 358 nm with strong intensity peak.**

Index Terms **- Dopant, Hexagonal, Nanoparticles, Porosity, Sol-gel.**

I.INTRODUCTION

Lanthanum oxide La_2O_3 and other metallic oxide have very unique properties, which make them suitable for a lot of applications such as catalysts [1], optical filters [2], metal support [3,4], water treatment [5-8], and dielectric material [9,10]. Last decades, the synthesis of novel nano complex oxides with uniform crystalline nano size, high purity, and homogeneity had brought much attention by researchers [11]. Nowadays, many approaches have been followed to synthesize them, for example, hydrothermal microwave synthesis [12,13], Solution combustion method [14], reverse micelle approach [15], sol-gel processing [16]. Various synthesis routes are used for preparation of the nanocrystalline rare earths metal oxides. Sol gel route is found to be better synthesis method for getting the particles size metal oxide powder with less agglomeration. The sol-gel process is a versatile soft chemical process, widely used for synthesizing metal oxide, ceramic and glass materials. This process as well influences the particle morphology all through the chemical transformation of the molecular precursor to final oxide. Lanthanum nitrate and Tin nitrate (30 and 40 percentage) were mixed with 0.01M citric acid using a magnetic stirrer. Viscous gel obtained by heating was dried in an air oven at 110 o C and calcined at 600 and 800 C for 2, 4, 6 hours to get the final powder. We report the synthesis of pure and Sn doped lanthanum oxide nanoparticles by sol gel method and characterization by XRD, FT-IR, UV- vis DRS, SEM and PL techniques.

II. RESULTS AND DISCUSSION

A. POWDER X-RAY DIFFRACTION STUDIES

The X-ray diffraction patterns sownin the Figures 1a b at room temperature revealed that, highly pure and Sn doped Lanthanum oxide nanoparticles It is clearly seen that all the peaks are coincide with 73-2141 JCPDS. It was confined single phase hexagonal structure and the crystallite sizes were calculated by using Debye-Scherre formula [17]. $D=K\lambda/\beta \cos\theta$ Hence K is a constant usually 0.9, and it belongs to the crystallite shape of prepared materials, λ is the wavelength of X-ray in nanometer, Θ is theta or the diffraction angle, and β is the peak width at half maximum height obtaining from small crystallite size in radians. The average crystalline size of pure and Sn doped lanthanum oxide nanoparticles is D=26 nm.

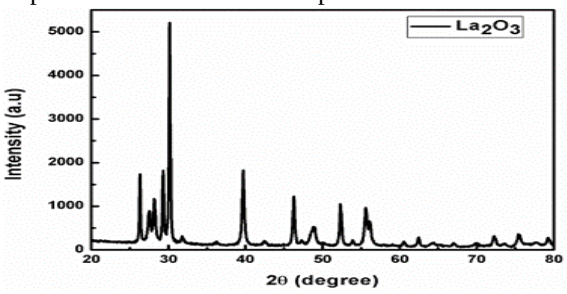

Fig:1a XRD pattern of pure Lanthanum oxide nanoparticles

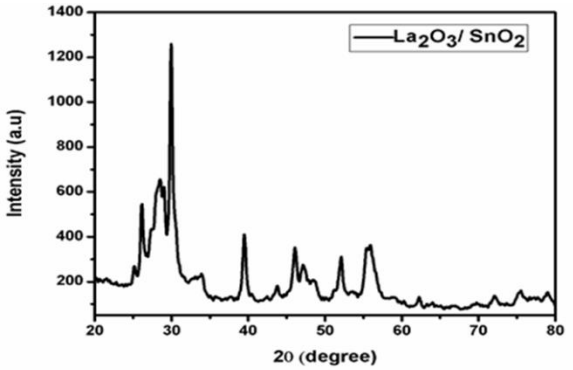

Fig :1b XRD pattern of Sn doped Lanthanum oxide nanoparticles

B. FOURIER TRANSFORM INFRARED (FT-IR) SPECTROSCOPY ANALYSIS

The metal -oxygen bonding and functional group existence in La_2O_3 nanoparticles were analyzed by using FT-IR studies. From the figure 2 a,b the observed wave number are in the range of 500-4000 cm^{-1}. A weak absorption band of water molecule appeared at 1623,1490,1377,1110 cm^{-1} and weak band observed at 3457 cm^{-1} are groups with carbon-hydrogen bonding. The strongly absorption band occur at 639 cm^{-1} and 874 cm^{-1} represent the metal oxygen stretching the formation of La_2O_3 nanoparticles. In addition, the medium band at 852 cm−1 is related to CO3 -2 stretching vibration that approves the formation of the carbonate. The peak observed at 563 cm-1 belongs to the stretching [18] of La–O, and this peak has demonstrated the formation of La_2O_3 after annealing at 850 °C.

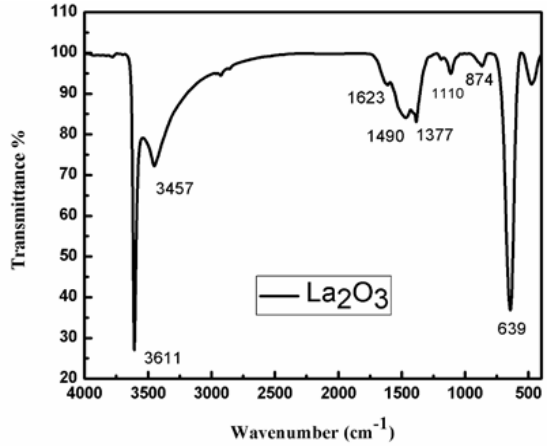

Fig: 2 a Fourier transform infrared (FT-IR) pattern of Lanthanum oxide nanoparticles

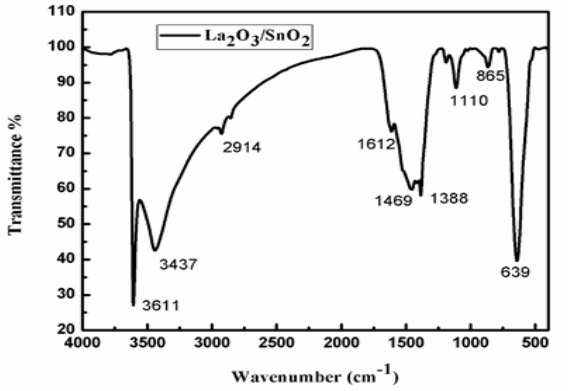

Fig: 2 b Fourier transform infrared (FT-IR) pattern of Sn doped Lanthanum oxide nanoparticles

C. MORPHOLOGICAL STUDIES

The morphology of the pure and Sn doped Lanthanum Oxide (La_2O_3) nanoparticles were studied using scanning electron microscope model SEM Quanta 200. From the figures 3a b shows that the particles have same morphology with a uniform porous surface[19]. From images, many pores of different sizes can be seen, which could make these materials suitable for different adsorption applications such as gas storage

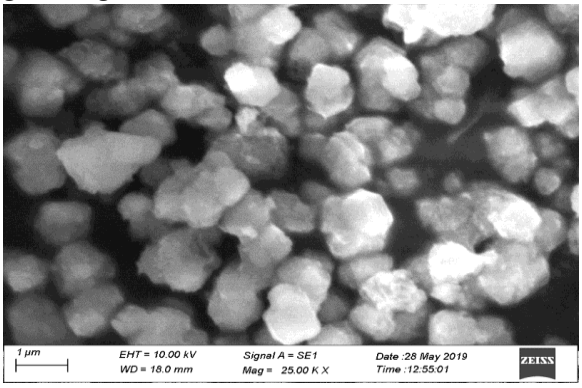

Fig:3 a SEM images of pure lanthanum oxide nanoparticles

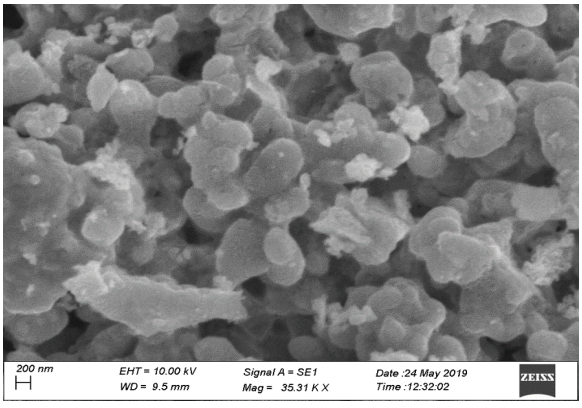

Fig: 3b SEM images of Sn doped lanthanum oxide nanoparticles

D.UV SPECTRA ANALYSIS

From figure UV spectra of pure lanthanum oxide and Sn doped lanthanum oxide nanoparticles. The Pure lanthanum oxide cut of wavelength 374 nm, when Sn doped lanthanum oxide nanoparticles cut off wavelength varied 194 nm. The result indicates doped lanthanum oxide nanoparticles cut of Wavelength decrease [20] it is behind the good electrical behavior exhibits the Sn doped lanthanum oxide nanoparticles

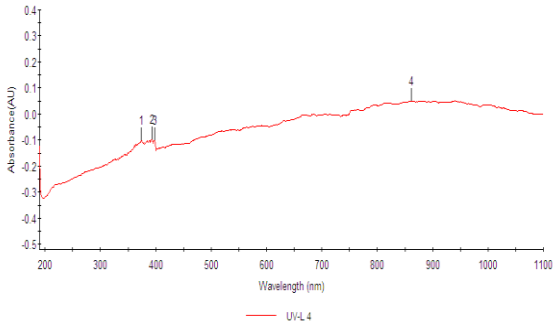

Fig: 4a UV Spetra for Lanthanum Oxide nanoparticles

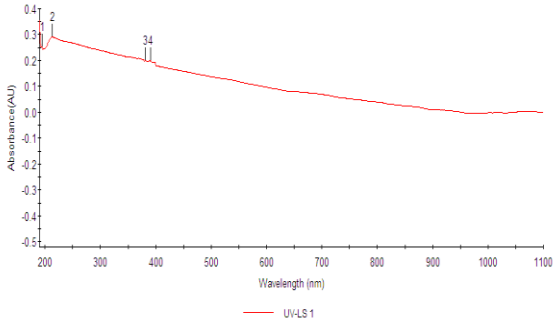

Fig:4b UV spectra for Tin doped Lanthanum Oxide nanoparticles

E.PHOTOLUMINESCENCE STUDIES

Photoluminescence (PL) spectra of pure lanthanum oxide and Sn doped lanthanum oxide nanoparticles. The excitation value of pure lanthanum oxide 374-861 nm and tin doped lanthanum oxide 194-391nm. The PL spectrum showed an emission maximum at 592nm with very strong intensity. The emission peaks appear at 592,651,710 nm. The spectrum for Sn doped lanthanum oxide shown in the figure 5 a.b an emission maximum at 358 nm with very strong intensity[21]. The emission peaks appear at 322,335,347,358, 368,379nm.

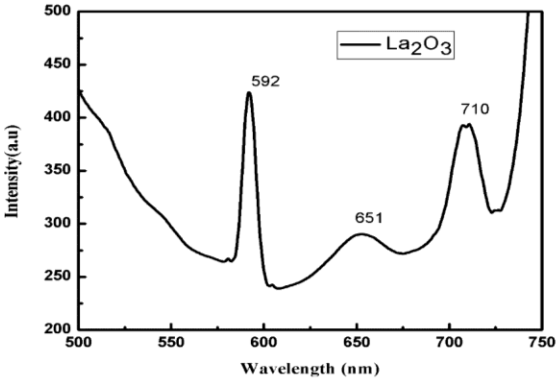

Fig :5a Photoluminescence (PL) for pure Lanthanum oxide nanoparticles

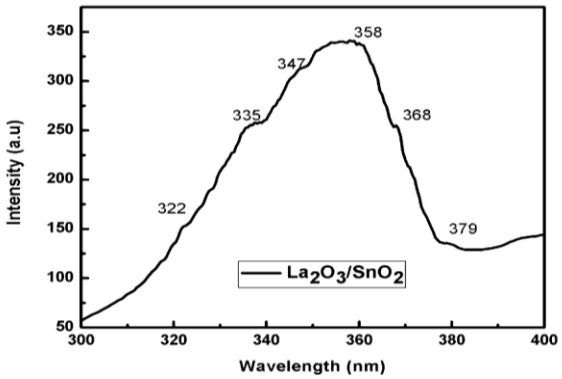

Fig: 5b Photoluminescence (PL) for Sn doped Lanthanum Oxide nanoparticles

III.CONCLUSION

La_2O_3 nanoparticles with the hexagonal structure were successfully synthesized by simple microwave assisted method. From the XRD crystal size was calculated using scherrer formula for pure lanthanum oxide is 26 nm and Sn doped lanthanum oxide 30nm. The Morphological studies revealed shape of the as-prepared La_2O_3nanoparticles and doped nanoparticles. It reveals that good electrical behavior of the materials. The functional group of synthesized material it confirmed by FT-IR Spectra. The PL spectrum for tin doped lanthanum oxide has shown maximum emission at 358nm with very strong intensity.

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