SYNTHESIS AND OPTICAL CHARACTERIZATION OF STRONTIUM OXIDE NANOPARTICLE

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ABSTRACT: Synthesis of strontium oxide is very remarkable for its applications in electrodes for gas sensors, solar cells, lithium-ion-batteries, transistors, super capacitors and semiconductors. This study is intended to synthesize SrO nanoparticle using a sol gel method. The crystalline nature, size, and morphological structure of SrO powder sample were characterized by techniques such as XRD, FTIR, SEM with EDAX, UV-Vis Spectroscopy, and PL spectral analysis. X-ray diffraction peaks indicate that the nanoparticles are crystalline in nature. The crystallite size of strontium oxide nanoparticles was calculated using Debye-Scherrer formula. The crystalline sizes are about 47.06 nm. The surface was scanned using SEM and EDAX and the results showcased the morphology and purity of the prepared sample. FTIR spectrum of strontium oxide confirmed the phase formation. The absorption peak exhibited at 280nm in UV region. In addition, it is demonstrated that the band gap energy was calculated to be 2.30eV. Photoluminescence study shows that the prepared nanoparticle having highefficient light emitting properties that could be suitably used for various lighting applications.
KEYWORDS: Strontium oxide, XRD, SEM, EDAX, FTIR, UV-visible, PL, SrO nanopowder.

I. INTRODUCTION

Nonmaterial's are cornerstones of nanoscience and nanotechnology. Nanostructure science is a broad and interdisplinary area of research and developing activity that has been growing explosively worldwide in the past few years. It has the potential for revolutionizing the ways in which materials and products are created and the range and nature of functionalities that can be accessed [1]. Different developing applications of nanotechnology utilize the unique properties arising from the nanoscale dimensions of nanomaterials [2].Research in the area of nanostructured materials have attracted wide attention due to their fascinating optical and electrical properties, which make these materials potentially suitable for applications in electronics, optics, photonics, and sensors.[3]. Among metal oxide nanocrystalline SrO shows excellent thermal stability and good optical properties. There are many different ways of synthesizing nanostructures like sol gel process, gas phase synthesis, chemical vapor condensation, laser ablation.Here sol gel method was employed for creating SrO nanoparticle.

II. EXPERIMENTAL

Sol gel method is used to prepare the sample which is simple and cost effective. All reagents used in the synthesis were analytical grade and used without further purification. 0.5M Strontium nitrate was dissolved in 500ml of distilled water and 0.5 M of sodium hydroxide was added drop wise and stirrer it for 15 minutes. A white precipitate appeared in the beaker. Fine powders were seen to be deposited. It was filtered using filter paper and kept for 2-3 days to dry. The dried fine powder is utilised for further analysis. X-ray diffraction analysis was performed on an X-ray diffractometer (sample stage 3071/xx) with copper target (l = 1.5405 A˚) in theta and 2 theta scan mode. FTIR analysis was performed on FTIR spectrophotometer (thermos Nicolet 380 FTIR spectrophotometer) and the wavelength range is from 4000 to 400$cm^{-1.}$ For SEM analysis model Jeol JSM6390 were used. .

III. STRUCTURAL CHARACTERIZATION

A. X- Ray Diffraction Studies

The crystal phase and purity of the synthesized SrO nanopowder were identified using the X-ray diffraction measurement. Fig. 1 shows the XRD pattern of strontium oxide nanoparticles prepared from NaOH precipitant. The XRD patterns confirms the polycrystalline nature with preferred orientation along (200) reflection plane. Other orientations such as (220), (222), (111) are observed in lower intensities. The crystallinity is conspicuous from the appearance of very narrow and sharp diffraction peaks. The lattice parameters are calculated using the standard formula $\frac{1}{d^2} = \frac{h^2+k^2+l^2}{a^2}$ Where h, k, l are the lattice planes and d are the interplanar spacing. The calculated lattice constant a=5.096Å is in good agreement with the standard value a=5.160Å. Crystallite size of SrO is calculated using Debye Scherrer's formula $D = \frac{k\lambda}{\beta \cos\theta}$ where k is the shape factor (0.9), λ is the wavelength of the X- ray, β is full with and half maxima, and θ is the angle of the diffraction and it is found to be 47.06 nm [2] 10].

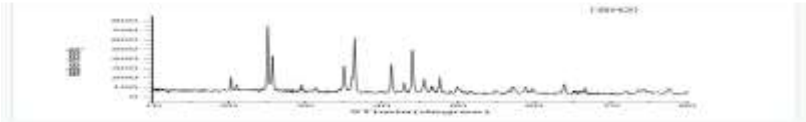

Fig.1 XRD pattern of Strontium Oxide nanopowder

B. FTIR

FTIR spectroscopy technique was used to obtain information about the binding of SrO NanoparticlesFTIR spectra of SrO nanoparticles were shown in fig 2.SrO nanoparticle has peaks between 500-1500 cm^{-1}. The peak at 856.92 cm^{-1} is attributed due to SrO bond. The sharp absorption bands at 1474.42 cm, 1384.70 cm, 1072.70cm, and 3383.14cm can be assigned due to O-H bending and C-O stretching vibrations.The presence of C-O, O-H, C-Cand C-N peaks indicates that SrO nanoparticles prepared can be used as reducing agent and also act as capping agent on the surface of metal oxide nanoparticles.

Fig. 2 FTIR Spectrum

C. SCANNING ELECTRON MICROSCOPY (SEM)

SEM studies have been carried out in order to understand the surface morphology of SrO as shown in fig 3. The nanostructure is observed having average grain size of 2.2 micrometer. SEM image shows flake-like morphology with nanoparticles agglomerations.

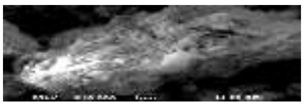

Fig 3. SEM image of SrO nanopowder

D. *ENERGY DISPERSIVE X-RAY (EDAX) SPECTROSCOPY*

The elemental composition of SrO nanoparticles is determined by using energy dispersive X-ray spectroscopy as shown in Fig. 4. The EDAX analysis indicates the presence of Strontium and Oxygen . The presence of Sodium in trace might have arisen from NaOH added to form the nano powders. Thus, the EDX analysis indicated that the prepared sample consisted the metal and oxygen components thereby confirm the purity of the synthesized sample .

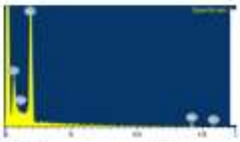

Fig 4 EDAX spectrum of SrO

Element	Weight %	Atomic weight%
O K	43.66	80.69
Na K	0.32	0.41
Sr	56.02	18.90

TABLE I

IV. OPTICAL PROPERTIES

The size of the nanoparticle plays an important role in changing the entire properties of materials Thus the size evolution of semiconducting nanoparticles becomes very essential to explore the properties of the materials. UV-Visible absorption spectroscopy is widely being used technique to examine the optical properties of nanosized particles. The absorption spectrum of the SrO nanoparticles synthesized in the present study was shown in fig 5.The UV-visible absorbance peak was observed at 280nm which indicates the synthesized SrO nanoparticles are pure and nano in their scale.

Fig. 5 UV- absorption spectra

Fig .6 tauc's plot

V. PHOTOLUMINESCENT PROPERTY

It is worth mentioning that the physical properties of semiconducting materials undergo changes when their dimensions get down to nanometer scale known as quantum size effects [1]. The PL spectrum indicates the excitation of SrO nanoparticles occurs at 320nm. The blue emission band and green emission band attributes to oxygen vacancy related defects. The yellow emission attributes to d-d transitions.

VI.CONCLUSION

SrO nanoparticles have been prepared using sol gel method and were characterized by XRD, FTIR, SEM with EDAX, UV-vis absorption, and photoluminescence spectroscopy. XRD confirmed the nanostructures for the prepared SrO nanoparticles. FTIR confirmed the phase formation by the appearance of SrO bond. The prepared SrO nanoparticle exhibits sharp UV band corresponding to near band gap excitonic emission and broad green emission band due to the oxygen vacancy at room temperature.Thus, it can be concluded that the prepared SrO nanoparticles can be used in different industrial applications such as luminescent material for fluorescent tubes, active medium for lasers, sensors .

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