



## Synthesis and Characterization of Strontium Oxide Nano Particle by Sol-Gel Method

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### ABSTRACT

Synthesis of strontium oxide nanoparticles was carried out by sol-gel method using strontium nitrate and sodium hydroxide at room temperature which is very simple and cost effective. The characterization of strontium oxide nanoparticles was done using X-ray diffraction, scanning electron microscopy (SEM) and Fourier transform infra-red (FTIR). X-ray diffraction pattern indicates that the nanoparticles are crystalline in nature. The crystalline size of strontium oxide nanoparticle was calculated by Debye-Scherrer formula. The crystalline sizes are about 80 nm. The morphology of nanoparticles was observed and investigated using SEM. The material at room temperature, calcined at 200°C, 400°C and 600°C respectively shows pseudo spherical shape, cubic form and finally it becomes cylindrical this shows that there is an agglomeration with increase in temperature. FTIR spectrum of strontium oxide shows the peak at 854.64 cm<sup>-1</sup> which is due to Sr-O bond.

**Keywords:** Strontium oxide, Nanoparticle, XRD, SEM, FTIR.

### INTRODUCTION

Strontium oxide nanoparticle had received great attention in basic and applied research for fabricating the devices because of its unique properties<sup>1-5</sup>.

Strontium oxide nanoparticle is used to design the devices for dye-sensitized solar cells, electrodes for lithium ion battery, super capacitors, transistors, doped semiconductors, solar cells and gas sensors because of its morphology<sup>6-10</sup>.

Growth of nanoparticles are depends

on many factors such as viscosity, temperature and concentration of the medium. The growth of nanoparticle changed in the dependence on method of preparation of nanoparticle. The methods of synthesis of nonmaterial solids had been improved due to materials, scientist and engineers<sup>11-14</sup>. Nanoparticles synthesis with unique properties is a new area of research which is a great importance. There are various methods to synthesize these materials in liquid phase such as hydrothermal<sup>15-18</sup>, sol-gel<sup>19-22</sup>, micro emulsion and microbial processes, out of these methods sol gel is a simple and cost effective method<sup>23</sup>. Due to different



physical and chemical properties such as higher damping property, mechanical stability and good thermal conductivity nanoparticles have received a great attention in last few years<sup>24</sup>. Nanomaterials are known for many novel properties due to their nanometer size; many novel applications are already known from these novel properties.

The synthesis of strontium oxide nanoparticles was carried out by biometric method using *ocimum sanctum* leaf extract<sup>6</sup> and by wet process<sup>10</sup>.

Therefore, the aim of this paper is to synthesize strontium oxide nanoparticle and investigate their morphology and uses in various fields which is a cost-effective method as compared to other methods.

## MATERIALS AND METHODS

### Reagents and chemicals

Strontium nitrate was obtained by E. Merck & Co. (India). All the other reagents and chemicals applied here were of AnalaR grade.

### Instrumentation

An Elico pH meter is used for measuring the pH level. Whereas for heating these samples at varying temperatures, a muffle furnace was used. FTIR spectra are done using an FTIR Nicolet 50X spectrophotometer model in the region of 400-4000  $\text{cm}^{-1}$  as KBr pellets.  $\text{CuK}\alpha$  radiations were applied in diffractometer PW1820 for recording powder X-ray diffraction. The morphological studies were accomplished by SEM.

### Synthesis

0.2M strontium nitrate solution was taken in a beaker and 0.5M NaOH solution was added drop wise, after few minutes the white precipitate of strontium hydroxide was appeared in a beaker. The pH of the solution was measured 12.6 by Elico pH meter. The precipitate was washed with methyl alcohol two to three times in order to remove ionic impurities. The product was centrifuged for 5 min at 5000 rpm/min and dried at room temperature.

## RESULT AND DISCUSSION

X-ray diffraction pattern shows crystalline nature of nanoparticle. Diffraction peaks match with the database (JCPDS file #6-520) which corresponds to  $\text{Sr}(\text{OH})_2$  with cubic structure. The Debye-Scherrer equation  $D = 0.94\lambda / \beta \cos\theta$ <sup>25</sup> was used to calculate the crystalline size, where  $\beta$  is the

full width at half maximum of peak.  $\lambda$  represents the X-ray wavelength and  $\theta$  referred as Bragg diffraction angle. The crystalline size is about 80nm. The X-ray diffraction pattern is shown in Figure 1.

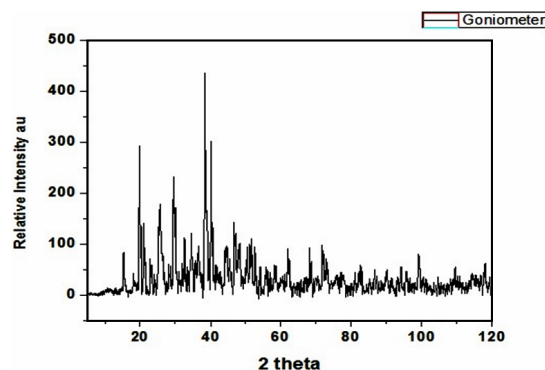


Fig. 1. Powder X-ray diffraction pattern of strontium oxide nanoparticles

Figure 2(a) shows SEM image of strontium oxide nanoparticle at room temperature which shows pseudo spherical shape. As the temperature increases up to 400°C it starts agglomeration and the shape becomes cubic Fig. 2(b&c). Finally it becomes cylindrical Fig. 2(d) on further increase of temperature up to 600°C. This shows that there is an agglomeration with increase in temperature.

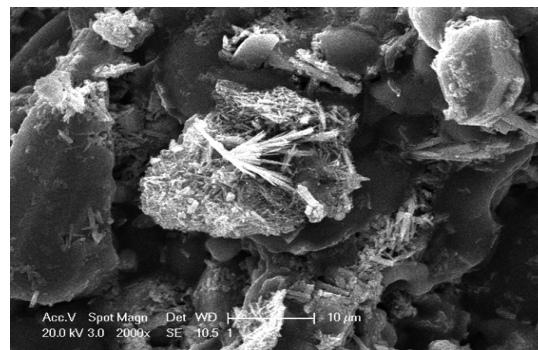


Fig. 2(a). SEM at room temperature of strontium oxide nanoparticles

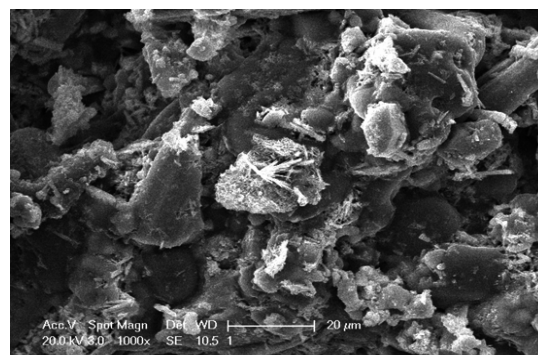


Fig. 2 (b). SEM at 200°C of strontium oxide nanoparticles

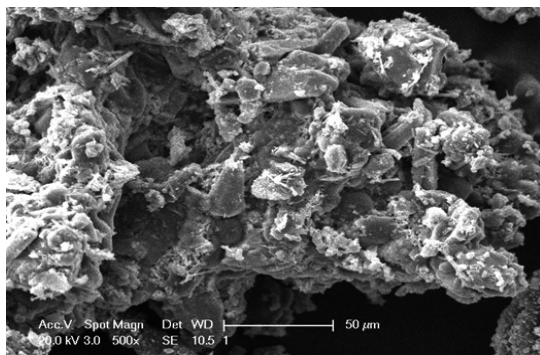


Fig. 2(c). SEM at 400°C of strontium oxide nanoparticles

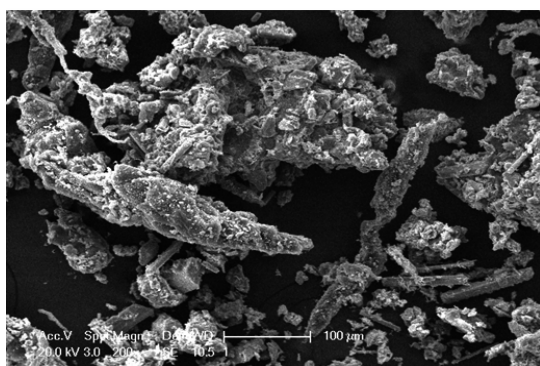


Fig. 2(d). SEM at 600°C of strontium oxide nanoparticles

FTIR spectrum of strontium oxide nanoparticle Fig. 3 shows the peak at 854.64  $\text{cm}^{-1}$  which is due to Sr-O bond<sup>26</sup>. A sharp peak at 1339.75  $\text{cm}^{-1}$ , 1788.45  $\text{cm}^{-1}$ , 2425.97  $\text{cm}^{-1}$  and, 2917.07  $\text{cm}^{-1}$  was because of H-O-H bending<sup>6,27</sup>. The peak at 3000-3600  $\text{cm}^{-1}$  region represents the -OH group and interstitial water molecule<sup>28</sup>

### CONCLUSION

Strontium oxide nanoparticles were

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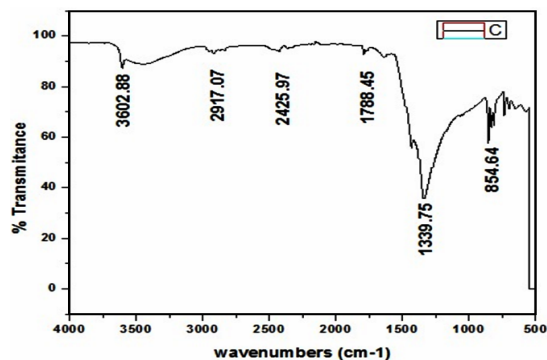


Fig. 3. FTIR spectrum of strontium oxide nanoparticles

synthesised using the sol-gel method. Material heated at 200°C, 400°C and 600°C. Characterization of SrO nanoparticles was done using X-ray diffraction, SEM and Fourier transform infra-red (FTIR). X-ray diffraction pattern indicates that nanoparticles are of a crystalline nature. The SrO nanoparticle crystalline size was calculated using the Debye-Scherrer formula. Around 80nm is the crystalline size. The material can be used to design lithium ion battery electrode devices, transistors, doped semiconductors, solar cells, and gas sensors.

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### Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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