

Synthesis of SnO Nanoparticles—A Hydrothermal Approach

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Abstract

SnO nanoparticles were prepared by addition of HCl to tin oxide solution. The synthesis process is simplified for SnO nuclei. We herein report a better-defined and simple procedure for synthesis of SnO particles in a simple hydrothermal process.

Keywords

Tin Oxide, XRD, SEM, Nanostructure, Precipitation, Urea

1. Introduction

Metal and metal oxide nanoparticles, differing from their bulk analogs in chemical, thermal, optical, magnetic and other properties, are widely used in catalysis, medicine, electronics and other fields. Many different methods of nanoparticle synthesis with the use of supercritical fluids (SCF) have been suggested, in particular, the reverse micelle, rapid expansion and hydrothermal synthesis methods [1] [2] and [3]. Among these methods hydrothermal process has the best advantages and possibilities for synthesis of metal and metal oxide nanoparticles [4] [5]. Metal oxide nanomaterials can completely degrade the contaminants with sunlight or UV radiation at room temperature and do not cause pollution [6]. These oxide nanomaterials include TiO₂ [7], ZnO [8], SnO [9] [10] and [11], and Fe₂O₃ [12].

SnO is an important semiconductor material with excellent chemical and physical performances. As an effective photocatalyst, SnO nanostructures can photodegrade organic pollutants to other nontoxic small molecules. In this work, we report on the synthesis of SnO nanoparticles using a one-pot hydro-

thermal method.

2. Synthesis of SnO Nanoparticles

The synthesis of SnO Nano particles was carried out by conventional Hydro-thermal protocol, $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ and Dil. HCl was used as synthesizing material. In a typical Procedure stock solutions of 0.1 M (2.3 g) $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$, solution was prepared in 50 ml of 1.0 M HCl under stirring. To this stock solution 250 ml of SnCl_2 (0.1 M) solution prepared in appropriate amount of urea was added under continuous stirring in order maintain the pH of reactants as 9. The solution was transferred into Teflon lined autoclave and maintained at 150°C for 1 hr under autogenous pressure. It was then allowed to cool naturally to room temperature. After the reaction was complete, the resulting white solid product was washed with distilled water to free the precipitates, filtered and then dried in air in a laboratory oven at 60°C . The same was shown in flow chart **Figure 1**.

3. Characterization Studies

3.1. XRD Study of SnO Nanoparticles

The XRD results reveal the presence of tetragonal stannous Oxide as shown in **Figure 2**. with orientation in (001), (101), (110), (002), (200), (112), (211), (202) and (103) planes at 18.2, 29.8, 33.2, 37.1, 44.3, 47.8, 50.7, 57.3 and 62.5 theta values corresponding to SnO and these values well matches with JCPDD No. 36-1451 data.

3.2. FT-IR Spectrum of SnO Nanoparticles

The FT-IR spectrum **Figure 3** of the SnO nanoparticles, the absorption peaks at

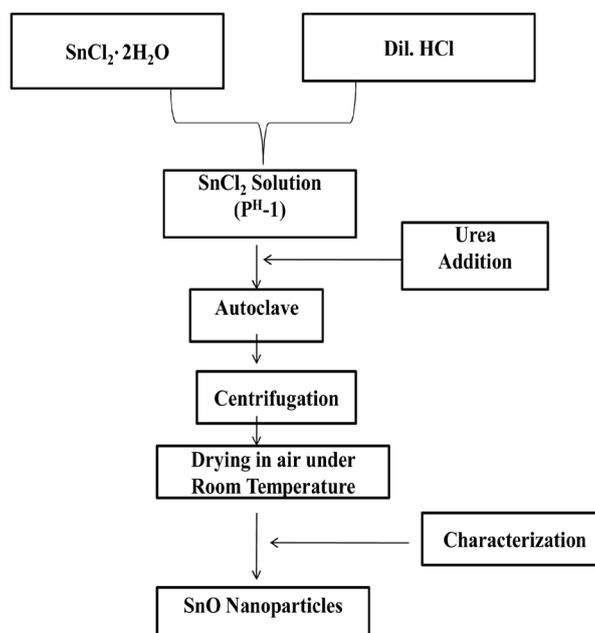


Figure 1. Flowchart for the synthesis of SnO Nanoparticles.

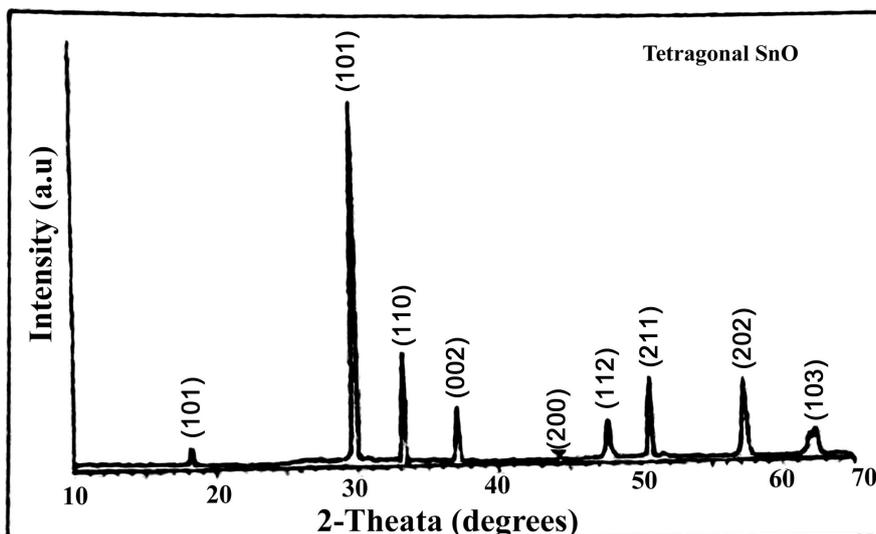


Figure 2. XRD of SnO Nanoparticles.

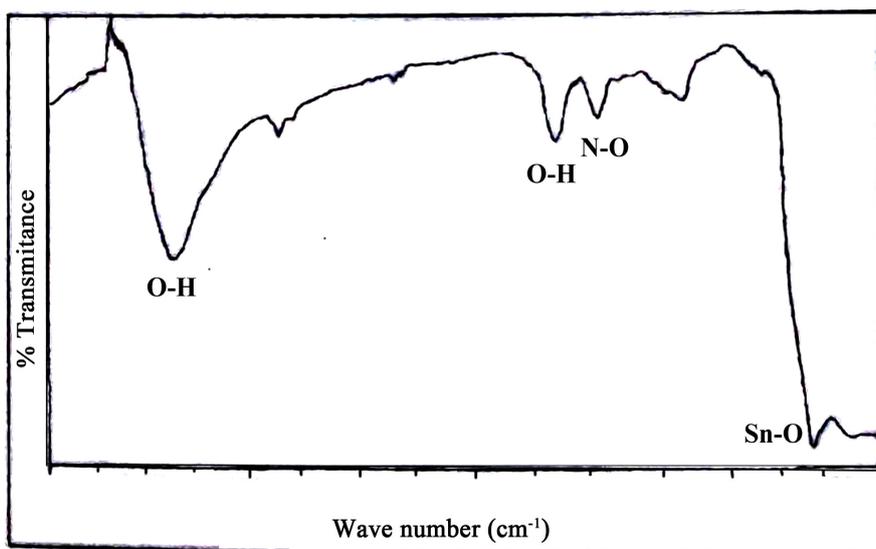


Figure 3. FT-IR spectrum of SnO nanoparticles.

3456 cm^{-1} and 1618 cm^{-1} are attributed mainly to the O-H stretching vibration of surface hydroxyl group or adsorbed water on the SnO nanoparticles. Peak observed at 1409 cm^{-1} is assigned to N-O. This may be from urea used in the experiment. The absorption band at 515 cm^{-1} is assigned to Sn-O vibration.

3.3. SEM Micrograph of SnO Nanoparticles

The SEM micrograph of SnO nanoparticles is shown in **Figure 4**. It is seen that the particles are mesoporous in nature with particle size of $\sim 50\text{ nm}$.

4. Conclusion

In the present communication, nanosized particles of SnO were successfully synthesized by hydrothermal process using tin chloride.

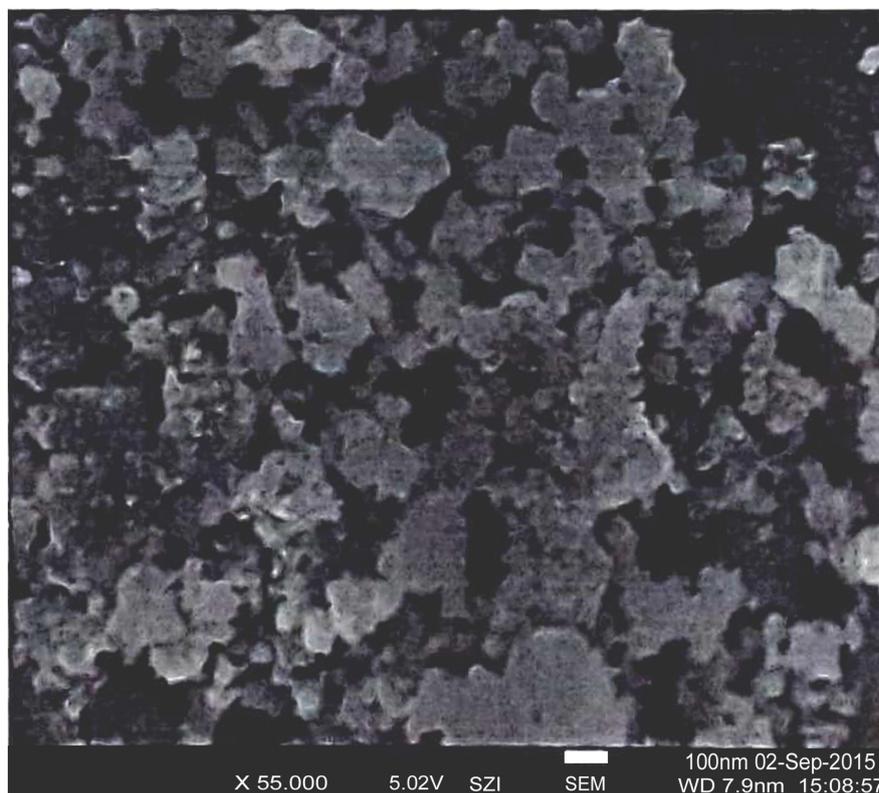


Figure 4. SEM micrograph of SnO nanoparticles.

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