Synthesis and Characterization of Tin Diselenide ($SnSe_2$) Nanoparticles for Optoelectronic Applications

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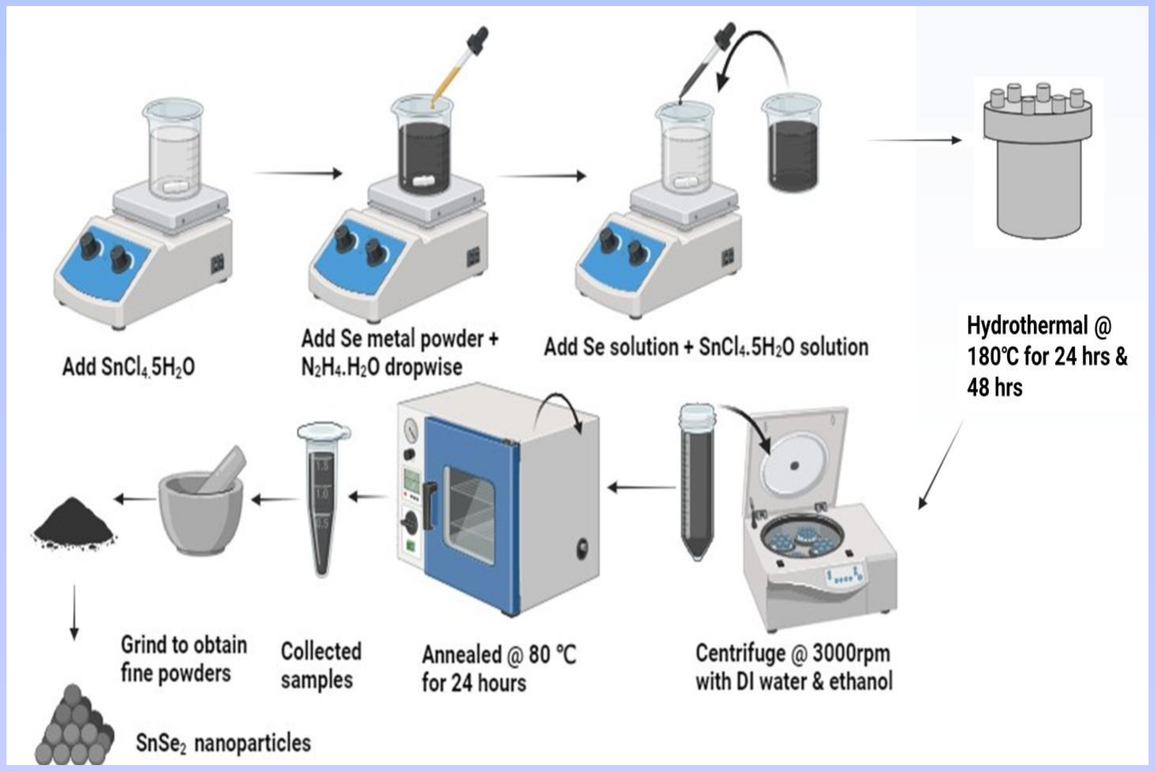
Introduction

- Tin diselenide ($SnSe_2$) is a binary compound n-type semiconductor which is having an optical bandgap of 1.0 eV in its bulk state and is used in a wide range of opto-electronic applications. A cost-effective and scalable wet-chemical technique for producing the ($SnSe_2$) nanoparticles is highly desirable for the rapid fabrication of devices.

- Here, we report the synthesis of ($SnSe_2$) based on a hydrothermal method technique and the morphological studies have been performed using Scanning electron microscopy.

Experimental Procedure



Scanning Electron Microscopic Results

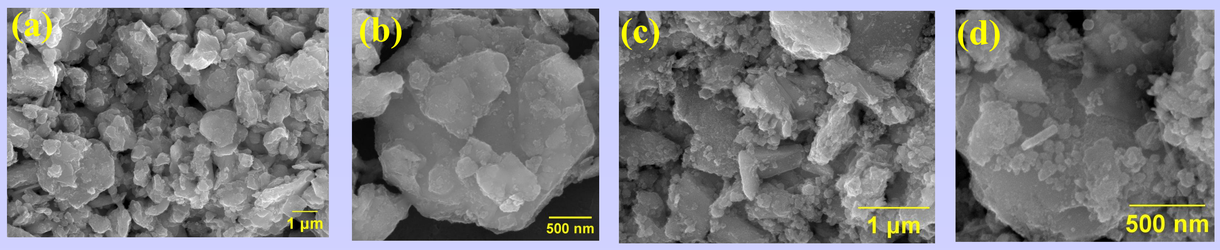


Fig.1 (a) ,(b), (c) and (d) SEM images of the as-synthesized $SnSe_2$ nanoparticles.

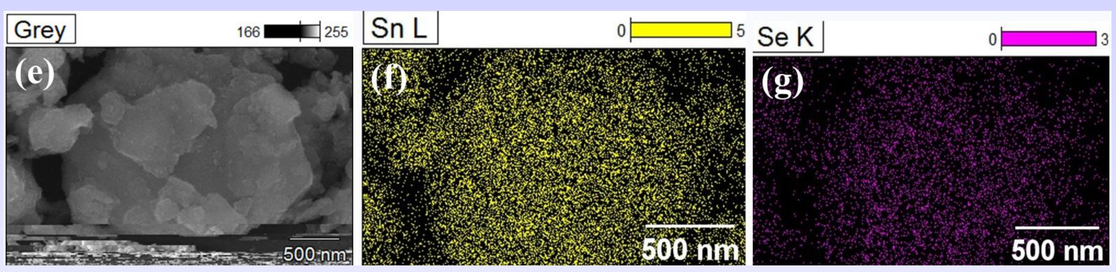


Fig.2 EDS elemental mappings for (f) Sn and (g) Se of $SnSe_2$ grown for 24h.

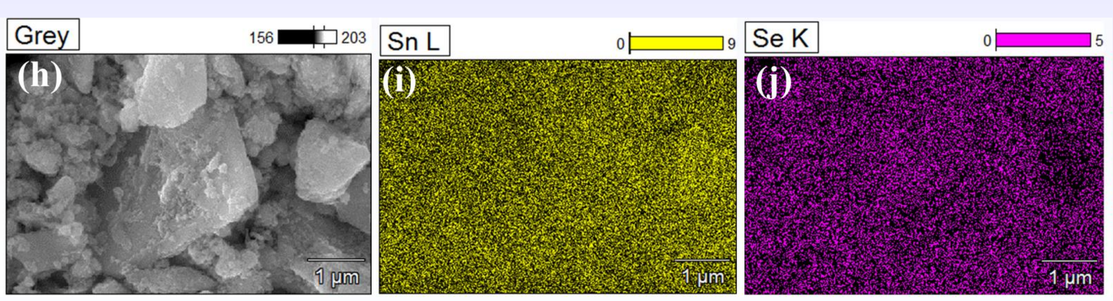


Fig.3 EDS elemental mappings for (i) Sn and (j) Se of $SnSe_2$ grown for 48h.

XRD Pattern

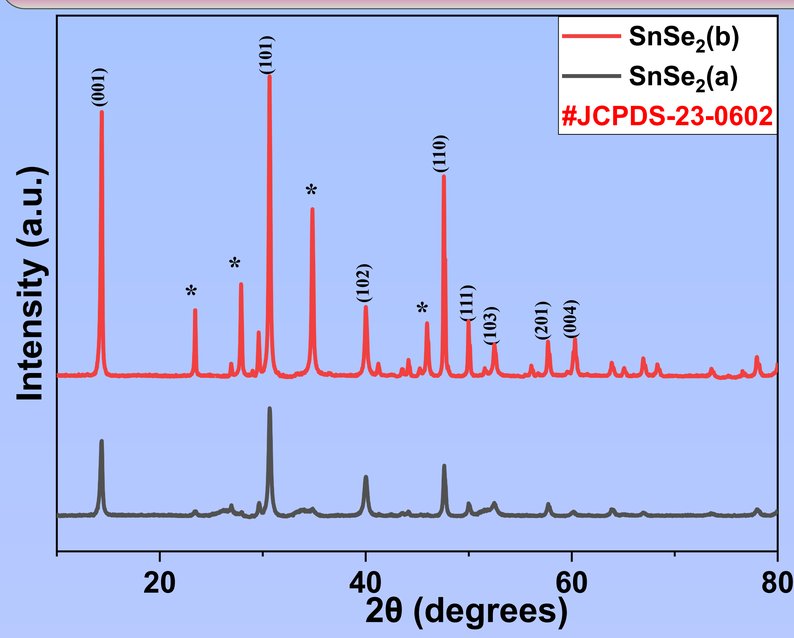


Fig.4 represents the XRD pattern of the as-synthesized $SnSe_2$ nanoparticles

Absorption Spectra

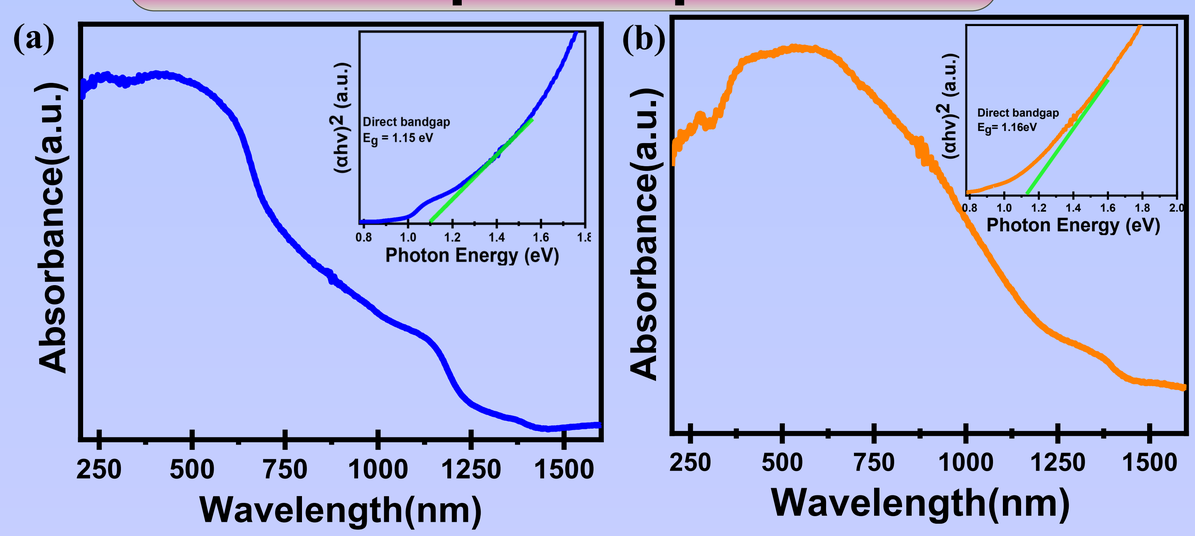


Fig.5 (a) and (b) The absorption spectra of the $SnSe_2$ nanoparticles grown at 24h and 48h respectively with the plot of $(\alpha h\nu)^2$ versus $h\nu$ (inset).

Conclusion

- $SnSe_2$ was synthesized by varying the parameters such as the Sn:Se ratios, growth hours, NaOH and hydrazine hydrate as reducing agent using the hydrothermal method.
- The formation and crystallinity of the synthesized $SnSe_2$ nanoparticles were confirmed using XRD characterization.
- The hexagonal morphology of the nanoparticles and nanoflakes of $SnSe_2$ were identified using SEM. The nanoflake-like structure indicates the anisotropic nucleation growth kinetics in the hydrothermal process.
- The optical bandgap of the fabricated $SnSe_2$ nanoparticles was found to be 1.15 eV and 1.16 eV respectively for the samples grown at 24h and 48h.

References

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2.Badhulika, Sushmee, RSC Publications (2022).

3.Chen, Guihuan, et al., CrystEngComm, 23.10 (2021): 2034-2038

Acknowledgements

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