Optimizing Sn Doping in Zn_4Sb_3 Thin Films: Insights into Processing and Electrical Performance

By Chen, CL (Chen, Cheng-Lung) ; Tang, BC (Tang, Bo-Chen) ; Chen, SC (Chen, Sheng-Chi) ; Wen, CK (Wen, Chao-Kuang) ; Chen, YH (Chen, Yin-Hung) ; Hairin, ALN (Hairin, Assayidatul Laila Nor)

View Web of Science ResearcherID and ORCID (provided by Clarivate)

Source CHEMSUSCHEM
Volume: 18 Issue: 11
DOI: 10.1002/cssc.202402690

Article Number e202402690

Published JUN 2 2025

Early Access MAR 2025

Indexed 2025-03-18

Document Type Article

Abstract beta-Zn4Sb3 is a promising thermoelectric material due to its environmental friendliness and suitability for mid-temperature applications which aligns with the development of renewable energy. However, maintaining its pure beta-phase during fabrication remains a significant challenge, as phase instabilities often degrade its thermoelectric performance. Here, we

demonstrate the successful optimization of beta-Zn4Sb3 thin films through controlled Sn doping using ion beam-assisted deposition. By precisely regulating the Sn concentration at 0.97 %, the beta-Zn4Sb3 phase is preserved, resulting in a maximum power factor of 1.4 mW m(-1) K-2 at 573 K-a 60 % improvement over undoped films. Comprehensive analyses reveal that dilute Sn doping enhances carrier mobility and structural stability while avoiding detrimental phase transitions to ZnSb. These findings highlight the importance of precise doping and processing control in stabilizing the beta-phase structure. This work provides a new pathway for fabricating high-quality thermoelectric thin films, offering valuable insights into the development of scalable, efficient energy harvesting technologies.

Keywords

Author Keywords: Thermoelectric; Zn4Sb3; Ion beam-assisted deposition; Doping; Energy efficiency; Renewable energy

Keywords Plus: THERMOELECTRIC PROPERTIES; ZINC; CONDUCTIVITY; ENERGY

Addresses

[1] Natl Chung Hsing Univ, Dept Phys, Taichung, Taiwan

[2] Ming Chi Univ Technol, Dept Mat Engn, New Taipei City 243, Taiwan

[3] Ming Chi Univ Technol, Ctr Plasma & Thin Film Technol, New Taipei City 243, Taiwan

[4] Chang Gung Univ, Coll Engn, Taoyuan, Taiwan

[5] Chang Gung Univ, Ctr Green Technol, Taoyuan, Taiwan

...more addresses

Categories/ Classification

Research Areas: Chemistry; Science & Technology - Other Topics

Citation Topics:	5	5.193	5.193.346
	Physics	› Thermoelectric Materials	› Thermoelectric Materials

Web of Science Categories

Chemistry, Multidisciplinary; Green & Sustainable Science & Technology

Language

English

Accession Number	WOS:001442039700001
PubMed ID	39995384
ISSN	1864-5631
eISSN	1864-564X
IDS Number	3IX1A

– See fewer data fields

Citation Network

In Web of Science Core Collection

0 Citations

32
Cited References

Use in Web of Science

3
Last 180 Days

3
Since 2013

This record is from:

Web of Science Core Collection

- Science Citation Index Expanded (SCI-EXPANDED)

Suggest a correction
If you would like to improve the quality of the data in this record, please Suggest a correction