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INSTITUTE OF SCIENCE & TECHNOLOGY  
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# International Conference on Advanced Functional Materials and Devices (AFMD-2024)

**February 26-29, 2024**

## PROCEEDINGS

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**Dr. E. Senthil Kumar**



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Nanotechnology Research Center  
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Kattankulathur, Chennai, Tamilnadu, India.

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## Upgraded Recycling of Cast-Iron Scrap Chips towards Fe-based Thermoelectric Materials for Waste-heat Energy Harvesting

Assayidatul Laila Nor Hairin<sup>\*1</sup>, Makoto Nanko<sup>2</sup>, Masatoshi Takeda<sup>3</sup>

<sup>1</sup>*Department of Manufacturing and Materials Engineering, Faculty of Engineering, International Islamic University, Jalan Gombak, Kuala Lumpur, Malaysia, 53100*

<sup>2,3</sup>*Department of Mechanical Engineering, Nagaoka University of Technology, Kamitomioka, Nagaoka, Niigata, 940-2188 Japan*

\*Corresponding author e-mail: assayidatul\_laila@iiu.edu.my

### ABSTRACT

In this research, an environmentally friendly and cost-effective production process involving the upgraded recycling of cast-iron scrap chips into thermoelectric materials based on iron (Fe) was proposed. The thermoelectric performance of Fe-based materials, including iron-silicide ( $\beta$ -FeSi<sub>2</sub>) and Heusler alloys (Fe<sub>2</sub>VAl), utilizing cast-iron scrap chips was thoroughly examined across temperatures ranging from room temperature to 800°C. The study identified an optimal dimensionless figure of merit, ZT (0.22 for n-type at 700°C and 0.17 for p-type at 700°C), making it a favourable starting material for producing  $\beta$ -FeSi<sub>2</sub> thermoelectric materials [1]. The development of n-type and p-type  $\beta$ -FeSi<sub>2</sub> modules was achieved, and the coefficient of thermal expansion was evaluated. Isothermal oxidation tests were conducted at 800°C in air for 14 days using an electric furnace to assess the oxidation behaviour of  $\beta$ -FeSi<sub>2</sub> prepared from cast-iron scrap chips [2]. The results indicated that  $\beta$ -FeSi<sub>2</sub> derived from cast-iron scrap chips exhibited a promising long lifetime at high temperatures (around 800°C) in air, showcasing excellent potential for stability in high-temperature thermoelectric devices when utilizing cast-iron scrap chips as a starting material. Furthermore, the thermoelectric performance of Fe<sub>2</sub>VAl, prepared using cast-iron scrap chips, demonstrated positive outcomes. The p-type Fe<sub>2</sub>VAl exhibited the highest power factor (PF) value of 1604  $\mu\text{Wm}^{-1}\text{K}^{-2}$  at 200°C. Additionally, undoped Fe<sub>2</sub>VAl, prepared from cast-iron scrap chips, showed a substantial improvement, with a PF value of 967  $\mu\text{Wm}^{-1}\text{K}^{-2}$  at 200°C, approximately twice that of previously reported values [3]. Unfortunately, the fabrication of n-type Fe<sub>2</sub>VAl specimens from cast-iron scrap chips was hindered by impurities present in the scrap chips' composition [4]. Despite this limitation, the use of cast-iron scrap chips for producing undoped and p-type Fe<sub>2</sub>VAl alloys holds potential for contributing to eco-friendly and cost-effective production processes. Ultimately, the research delves into comprehensive guidelines aimed at enhancing recycling processes, with a specific emphasis on esteemed intermetallic compounds. This exploration occurs within the broader framework of elevating the recycling of cast-iron scrap chips, representing a significant endeavour to mitigate the abundance of waste and advance toward a more environmentally friendly and cost-effective production paradigm.

### References:

1. Laila, A., Nanko, M., & Takeda, M., Mater. Trans., 57 (3) (2016), 455-451.
2. Nanko, M., Chang, S. H., Matsumaru, K., Ishizaki, K., & Takeda, M., Materials Science Forum, 522 (2006), 641-648.
3. Laila, A., Nanko, M., & Takeda, M., Mater. Trans., 61 (11) (2020), 2216-221.
4. Abe, K., Kikuchi, A., Okinaka, N., & Akiyama, T., J. Alloy. Comp., 611 (2014), 319-323.



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(Deemed to be University Under section 3 of UGC Act 1956)

SRM Nagar, Kattankulathur, Chengalpattu District

Chennai, Tamil Nadu, India - 603203

Telephone: +91-44-27417000, +91-44-27417777

Website: <https://www.srmist.edu.in/>



### **For further details, Contact**

Conference Secretariat : AFMD-2024

Phone : +91-44-24717190

Mobile : +91 87544 20369 | +91 98439 15660

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