Scopus

Documents

Rahman, A., Abdi, Y., Aung, K.M., Ihsan, S.

Nano-Structured Zinc Oxide/Silicon Dioxide Thermoelectric Generator: A Waste Heat Harvesting Technology
(2023) *Lecture Notes in Mechanical Engineering*, pp. 517-523.

DOI: 10.1007/978-981-19-9509-5_68

Kulliyyah of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia

Abstract
Internal Combustion Engine in Hybrid powered transportation system is combating issues such as rising power costs, pollution, and global warming. The exhaust of internal combustion engines wastes a significant amount of fuel energy. Many academics are attempting to develop the waste energy harvesting- based power generator in order to reduce the negative effects. However, they have achieved only 5–7% of waste energy harvesting. The goal of this work is to describe a semiconductive thermoelectric generator (STEG) that uses a semi- conductive zinc oxide (ZnO)/silicon di-oxide (SiO2) composite to achieve a waste energy harvesting efficiency of 10–15%. The samples for the STEG models have been developed using ZnO blended epoxy resin and hardener for n-type and SiO2 blended epoxy resin and hardener pasted on CF for p-type. STEG models have made by sandwiching dielectric film by p-type and n-type SC. Each of the final samples has a 100 mm2 surface area. The STEG samples were examined in the electronic lab using Keithley Parametric Analyzer software to determine the best composition based on the performance of electric conductivity (σ), short circuit current density (Jsc), open circuit voltage (Voc), zT merits, seeback coefficient (α) and conversion efficiency (ηcon). The samples were tested with applying heat externally at 150 °C. The best results were obtained for the sample of 30 wt.% of ZnO and 70% of SiO2 as σ of 5.4xe8m1Ω1, Voc of 525 mV, Jsc of 14 × 10–9 A/m2 and ηcon of 15%. © 2023, The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd.

Author Keywords
Current density; Semi-conductive thermoelectric generator; Synthesising and characterization; Waste heat energy harvesting

Index Keywords
Aspect ratio, Conversion efficiency, Electric generators, Electronic equipment, Energy harvesting, Global warming, II-VI semiconductors, Open circuit voltage, Silicon oxides, Thermoelectric equipment, Waste heat, Waste incineration, Wide band gap semiconductors, Zinc oxide; Generator modelling, Heat energy, Nano-structured, P-type, Semi-conductive thermoelectric generator, Semiconductive, Synthesizing and characterization, Thermoelectric generators, Waste energy, Waste heat energy harvesting; Silica

References

- Snyder, G.J.
  Small thermoelectric generators
  (2008) *Electrochem Soc Interface*, 17, p. 54.
- Mohamed, H.E., Dhafer, A.D., Faizul, M.S., Suhana, M.S., Masjuki, H.H., Bashir, A.B., Mahazani, M.
  A review on thermoelectric renewable energy: Principle parameters that affect their performance
  (2014) *Renew Sustain Energy Rev*, 30, pp. 337-355.
- Riffat, S.B., Ma, X.
  Thermoelectrics: A review of present and potential applications
  (2003) *Appl Therm Eng*, 23, pp. 913-935.
- Basu, R., Bhattacharya, S., Bhatt, R., Roy, M., Ahmad, S., Singh, A., Gupta, S.K.
  Improved thermoelectric performance of hot pressed nanostructured n-type SiGe bulk alloys
  (2014) *J Mater Chem A*, 2 (19), pp. 6922-6930.
- Roberto, S., Lars, S., Michael, P.D.
  Electrical conductivity of SiO2 at extreme conditions and planetary dynamos
  (2017) *Proc Natl Acad Sci of the USA*, 114 (34), pp. 9009-9013.

- Minnich, A.J., Dresselhaus, M.S., Ren, Z.F.G., Chen, G.
Bulk nanostructured thermo-electric materials: Current research and future prospects
(2009) *Energy Environ Sci*,

- Goupil, C., Seifert, W., Zabrocki, K., Müller, E.G.J., Snyder, G.J.
(2011) *Thermodynamics of Thermoelectric Phenomena and Applications. Entropy*,

- Omer, S.A., Infield, D.G.
Design and thermal analysis of two stage solar concentrator for combined heat and thermoelectric power generation
(2000) *Energy Convers Manage*, 41, pp. 737-756.

- Yadav, A., Pipe, K.P., Shtein, M.
Fiber-based flexible thermoelectric power generator
(2008) *J Power Sources*, 175, pp. 909-913.

- Ataur, R., Abdul, R.F., Hawlader, M.N.A., Rashid, M.
Nonlinear modeling and simulation of waste energy harvesting system for hybrid engine: Fuzzy logic approach
(2013) *J Renew Sustain Energy*, 5 (3), pp. 1-13.

- Ataur, R., Fadhialh, R., Afroz, R., Hawlader, M.N.A., Mohiuddin, A.K.M.
Power generation from the waste of IC engine. J Renew Sustain Energy Rev
(2015) *Elsevier Publisher*, 51, pp. 382-395.

- Liang, S., Zheng, D., Standley, D.M., Guo, H., Zhang, C.
A novel function prediction approach using protein overlap networks
(2013) *BMC Syst Biol*, 7, p. 61.

- Nam, W.H., Lim, Y.S., Choi, S.M., Seo, W.S., Lee, J.Y.
High-temperature charge transport and thermoelectric properties of a degenerately Al-doped ZnO nanocomposite
(2012) *J Mater Chem*, 22, pp. 14633-14638.

- Champier, D.
Thermoelectric generators: A review of present and future applications
(2016) *Springer Proceedings in Energy*, pp. 203-212.
Springer Science and Business Media LLC: Cham, Switzerland

Correspondence Address
Rahman A.; Kulliyyah of Engineering, Malaysia; email: arat@iium.edu.my

Editors: Maleque M.A., Ahmad Azhar A.Z., Sarifuddin N., Syed Shaharuddin S.I., Mohd Ali A., Abdul Halim N.F.
Publisher: Springer Science and Business Media Deutschland GmbH

Conference name: 5th International Conference on Advances in Manufacturing and Materials Engineering, ICAMME 2022
Conference date: 9 August 2022 through 10 August 2022
Conference code: 294689

ISSN: 21954356
ISBN: 9789811995088
Language of Original Document: English
Abbreviated Source Title: Lect. Notes Mech. Eng.
2-s2.0-85161181023
Document Type: Conference Paper
Publication Stage: Final
Source: Scopus