A Novel Electro Conductive Graphene/Silicon-Dioxide Thermo-Electric Generator

By: Rahman, A (Rahman, Ataur)[1]; Abdi, Y (Abdi, Yusuf)[1]

3RD INTERNATIONAL CONFERENCE ON MECHANICAL, AUTOMOTIVE AND AEROSPACE ENGINEERING 2016
Book Group Author(s): IOP
Book Series: IOP Conference Series-Materials Science and Engineering
Volume: 184
Article Number: UNSP 012025
DOI: 10.1088/1757-899X/185/1/012025
Published: 2017
Document Type: Proceedings Paper

Conference

Conference: 3rd International Conference on Mechanical, Automotive and Aerospace Engineering (ICMAAE)
Location: Int Islam Univ Malaysia, Kulliyyah Engn, Kuala Lumpur, MALAYSIA
Date: JUL 25-27, 2016

Abstract

Thermoelectric generators are all solid-state devices that convert heat energy into electrical energy. The total energy (fuel) supplied to the engine, approximately 30 to 40% is converted into useful mechanical work; whereas the remaining is expelled to the environment as heat through exhaust gasses and cooling systems, resulting in serious green house gas (GHG) emission. By converting waste energy into electrical energy is the aim of this manuscript. The technologies reported on waste heat recovery from an exhaust gas of internal combustion engines (ICE) are thermoelectric generators (TEG) with finned type, Rankine cycle (RC) and Turbocharger. This paper has presented an electro-conductive graphene oxide/silicon-dioxide (GO-SiO2) composite sandwiched by phosphorus (P) and boron (B) doped silicon (Si) TEG to generate electricity from the IC engine exhaust heat. Air-cooling and liquid cooling techniques adopted conventional TEG module has been tested individually for the electricity generation from IC engine exhausts heat at the engine speed of 1000-3000rpm. For the engine speed of 7000 rpm, the maximum voltage was recorded as 1.12V and 4.00V for the air cooling and liquid cooling respectively. The GOSiO(2) simulated result shows that it's electrical energy generation is about 80% more than conventional TEG for the exhaust temperature of 500 degrees C. The GO-SiO2 composite TEG develops 524W to 1600W at engine speed 1000 to 5000 rpm, which could contribute to reduce the 10-12% of engine total fuel consumption and improve emission level by 20%.

Keywords

KeyWords Plus: RECOVERY; WASTE; HEAT; MOBILITY

Author Information

Reprint Address: Rahman, A (reprint author)

+ Int Islamic Univ Malaysia, Kulliyyah Engn, Dept Mech Engn, Kl 50728, Malaysia.

Addresses:

+ [1] Int Islamic Univ Malaysia, Kulliyyah Engn, Dept Mech Engn, Kl 50728, Malaysia

E-mail Addresses: arat@iium.edu.my

Publisher

IOP PUBLISHING LTD, DIRAC HOUSE, TEMPLE BACK, BRISTOL BS1 6BE, ENGLAND

Categories / Classification

Research Areas: Engineering; Materials Science

Web of Science Categories: Engineering, Aerospace; Engineering, Mechanical; Materials Science, Multidisciplinary

See more data fields

Cited References: 24

Showing 24 of 24 **View All in Cited References page** *(from Web of Science Core Collection)*

1. Title: [not available] **Times Cited: 2**
By: Ahn, J.; Ronney; Haile, S. M.
5 INT FUEL CELL SCI Article Number: 250832 Published: 2007

2. **Instantaneous Heat Transfer Rates to the Cylinder Head Surface of a Small Compression-Ignition Engine** **Times Cited: 61**
By: Annand, W.J.D.
P I MECH ENG Volume: 185 Pages: 976-987 Published: 1970

3. **A special thermocouple for measuring transient temperatures** **Times Cited: 55**
By: Bendersky, D. A.
Mech. Eng. Volume: 75 Pages: 117-121 Published: 1953

4. **Ultrahigh electron mobility in suspended graphene** **Times Cited: 4,462**
By: Bolotin, K. I.; Sikes, K. J.; Jiang, Z.; et al.
SOLID STATE COMMUNICATIONS Volume: 146 Issue: 9-10 Pages: 351-355 Published: JUN 2008

5. **Recovery of exhaust and coolant heat with R245fa organic Rankine cycles in a hybrid passenger car with a naturally aspirated gasoline engine** **Times Cited: 73**
By: Boretti, Alberto
APPLIED THERMAL ENGINEERING Volume: 36 Pages: 73-77 Published: APR 2012

6. Title: [not available] **Times Cited: 1**
By: CONKLIN JC
J ENERGY Volume: 35 Pages: 1658 Published: 2010

7. **HD Diesel engine equipped with a bottoming Rankine cycle as a waste heat recovery system. Part 1: Study and analysis of the waste heat energy** **Times Cited: 120**
By: Dolz, V.; Novella, R.; Garcia, A.; et al.
APPLIED THERMAL ENGINEERING Volume: 36 Pages: 269-278 Published: APR 2012

8. **Extraordinary mobility in semiconducting carbon nanotubes** **Times Cited: 960**
By: Durkop, T; Getty, SA; Cobas, E; et al.
NANO LETTERS Volume: 4 Issue: 1 Pages: 35-39 Published: JAN 2004

9. **Theoretical and experimental investigation of an organic Rankine cycle for a waste heat recovery system** **Times Cited: 47**
By: Gu, W.; Weng, Y.; Wang, Y.; et al.
PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART A-JOURNAL OF POWER AND ENERGY Volume: 223 Issue: A5 Pages: 523-533 Published: AUG 2009

10. **Performance of a thermoacoustic sound wave generator driven with waste heat of automobile gasoline engine** **Times Cited: 25**
By: Hatazawa, M.; Sugita, H.; Ogawa, T.; et al.
Transactions of the Japan Society of Mechanical Engineers Part B Volume: 70 Pages: 292-299 Published: 2004
[Show additional data]

11. Title: [not available] **Times Cited: 14**
By: Haywood, J.B.
Internal Combustion Engine Fundamentals Published: 1988
Publisher: McGraw Hill

12. **Nonlinear modeling and simulation of waste energy harvesting system for hybrid engine: Fuzzy logic approach** **Times Cited: 4**
By: Rahman, A; Abdul Razak, F; Hawlader, MNA; et al.
Journal of Renewable and Sustainable Energy Volume: 5 Issue: 3 Pages: 1-13 Published: 2013

[Show additional data]

13. Power generation from waste of IC engines — Times Cited: 13
By: Rahman, Ataur; Razzak, Fadhilah; Afroz, Rafia; et al.
RENEWABLE & SUSTAINABLE ENERGY REVIEWS Volume: 51 Pages: 382-395 Published: NOV 2015

14. Reciprocating internal coinlystion engines — Times Cited: 3
By: Reitz, RD.
engine research censer Published: 2012
Peincelien CEFRC
Publisher: University of Wisconsin-Madison

15. A review on compressed-air energy use and energy savings — Times Cited: 162
By: Saidur, R.; Rahim, N. A.; Hasanuzzaman, M.
RENEWABLE & SUSTAINABLE ENERGY REVIEWS Volume: 14 Issue: 4 Pages: 1135-1153 Published: MAY 2010

16. Thermoelectric power generation: efficiency and compatibility — Times Cited: 24
By: Snyder, G.
Thermoelectrics Handbook: Macro to Nano Published: 2006

17. Automotive applications of high efficiency thermoelectrics — Times Cited: 2
By: Stabler, F.
DARPA ONR PROGRAM RE Published: 2002

18. The potential for thermo-electric devices in passenger vehicle applications — Times Cited: 1
By: Stobart, P.K.
SAE Paper nso. 2010-01-0833 Published: 2010
Part 2 of 3 Presented at
Publisher: Advanced Hybrid Vehicle Powertrains, Detroit, MI, USA, Session

19. An availability approach to thermal energy recovery in vehicles — Times Cited: 1
By: Stobart, RK.
Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering Volume: 221 Issue: 1 Pages: 70-79 Published: 2007
P. K

20. Experimental investigation of two-dimensional wall thermal loads in the near-injector region of a film-cooled combustion chamber — Times Cited: 3
By: Wang, T.; Sun, B.; Liu, D.; et al.
Applied Thermal Engineering
available from Accessed on 24 April, 2018
URL: https://www-sciencedirect-com.ezproxy.um.edu.my/science/article/pii/S1359431117381188
[Show additional data]

21. Electrical and thermal conductivities of reduced grapheme oxide/ polystyrene composites. — Times Cited: 1
By: Wonjun, P.
Applied Physics Letter Volume: 104 Issue: 11 Pages: 1-13 Published: 2014

22. A universally applicable equation for the instantaneous heat transfer coefficient in the internal combustion engine — Times Cited: 412
By: Woschni, G.
SAE technical paper 670931 Published: 1967

23. Potential applications of thermoelectric waste heat recovery in the automotive industry — Times Cited: 29
By: Yang, J
ICT: 2005 24TH INTERNATIONAL CONFERENCE ON THERMOELECTRICS Pages: 155-159 Published: 2005

24. Thermoelectric automotive waste heat energy recovery using maximum power point tracking — Times Cited: 171
By: Yu, Chuang; Chau, K. T.
ENERGY CONVERSION AND MANAGEMENT Volume: 50 Issue: 6 Pages: 1506-1512 Published: JUN 2009

Showing 24 of 24 View All in Cited References page