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

By: Rahman, A [Rahman, Ataur]1,2; Abdi, Y [Abdi, Yusuf]1,2

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/184/1/012025
Published: 2017
Document Type: Proceedings Paper

Conference
Conference: 3rd International Conference on Mechanical, Automotive and Aerospace Engineering (ICMAAE)
Location: Int Islam Univ Malaysia, Kulliyyah Engh, 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 gases 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 1000-3000 rpm. 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 GO/SiO2 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 52W 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)
Address: Int Islamic Univ Malaysia, Kulliyyah Engh, Dept Mech Engh, KI 50728, Malaysia
E-mail Address: 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]  
By: Ahn, J.; Ronney; Haile, S. M.  
S INT FUEL CELL SCI Article Number: 250832 Published: 2007 | Times Cited: 2 |
|---|---|---|
| 2. | Instantaneous Heat Transfer Rates to the Cylinder Head Surface of a Small Compression-Ignition Engine  
By: Annand, W.J.D.  
| 3. | A special thermocouple for measuring transient temperatures  
By: Bendersky, D. A.  
| 4. | Ultrahigh electron mobility in suspended graphene  
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 | Times Cited: 4,462 |
| 5. | Recovery of exhaust and coolant heat with R245fa organic Rankine cycles in a hybrid passenger car with a naturally aspirated gasoline engine  
By: Boretti, Alberto  
APPLIED THERMAL ENGINEERING Volume: 36 Pages: 73-77 Published: APR 2012 | Times Cited: 73 |
| 6. | Title: [not available]  
By: CONKLIN JC  
J ENERGY Volume: 35 Pages: 1658 Published: 2010 | Times Cited: 1 |
| 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  
By: Dolz, V.; Novella, R.; Garcia, A.; et al.  
APPLIED THERMAL ENGINEERING Volume: 36 Pages: 269-278 Published: APR 2012 | Times Cited: 120 |
| 8. | Extraordinary mobility in semiconducting carbon nanotubes  
By: Durkop, T.; Getty, S.A; Cobas, E.; et al.  
| 9. | Theoretical and experimental investigation of an organic Rankine cycle for a waste heat recovery system  
By: Gu, W.; Weng, Y.; Wang, Y.; et al.  
| 10. | Performance of a thermoacoustic sound wave generator driven with waste heat of automobile gasoline engine  
By: Hatazawa, M.; Sugita, H.; Ogawa, T.; et al.  
| 11. | Title: [not available]  
By: Haywood, J.B.  
| 12. | Nonlinear modeling and simulation of waste energy harvesting system for hybrid engine: Fuzzy logic approach  
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 | Times Cited: 4 |
13. **Power generation from waste of IC engines**
   By: Rahman, Ataur; Razzak, Fadhillah; Afroz, Rafia; et al.
   RENEWABLE & SUSTAINABLE ENERGY REVIEWS Volume: 51 Pages: 382-395 Published: NOV 2015
   Times Cited: 13

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

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

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

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

18. **The potential for thermo-electric devices in passenger vehicle applications**
   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
   Times Cited: 1

19. **An availability approach to thermal energy recovery in vehicles**
   By: Stobart, RK
   P. K
   Times Cited: 1

20. **Experimental investigation of two-dimensional wall thermal loads in the near-injector region of a film-cooled combustion chamber**
    By: Wang, T.; Sun, B.; Liu, D.; et al.
    Applied Thermal Engineering available from Accessed on 24 April, 2018
    URL: https://www.sciencedirect.com/science/article/pii/S1359431117381148
    [Show additional data]
    Times Cited: 3

21. **Electrical and thermal conductivities of reduced graphene oxide/ polystyrene composites.**
    By: Wenjuan, P.
    Times Cited: 1

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

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

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