

ISSN 2076-2895 (Print)
ISSN 2076-2909 (Online)

International Journal of Energy and Environment



Volume 11, Issue 3, 5 December 2020

The Official Journal of the International Energy and Environment Foundation

INTERNATIONAL JOURNAL OF ENERGY AND ENVIRONMENT

**Official Journal of the International Energy and
Environment Foundation**

ISSN 2076-2895 (Print) ISSN 2076-2909 (Online)

Volume 11, Issue 3, 2020

© 2020 International Energy and Environment Foundation. All rights reserved

Aims and Scope

The International Journal of Energy and Environment (IJEE) is the official journal of the International Energy and Environment Foundation (IEEF). The journal is a multi-disciplinary, peer-reviewed open access journal, covering all areas of energy and environment related fields that apply to the science and engineering communities. The journal enjoys the full support of the IEEF, who provide funds to cover all costs of publication, including the Article Processing Charges for all authors. Therefore the journal is both free to read and free to publish in for everyone. IJEE aims to promote rapid communication and dialogue among researchers, scientists, and engineers working in the areas of energy and environment. The journal provides a focus for activities concerning the development, assessment and management of energy and environment related programs. The emphasis is placed on original research, both analytical and experimental, which is of permanent interest to engineers and scientists, covering all aspects of energy and environment. It is hoped that this journal will prove to be an important factor in raising the standards of discussion, analyses, and evaluations relating to energy and environment programs. All articles with significant research results in the areas of energy and environment and their application are welcome.

The scope of the journal encompasses the following:

Energy

- Fuel cells and their applications.
- Hydrogen energy.
- Photovoltaic technology conversion.
- Solar thermal applications.
- Wind energy.
- Hydro energy.
- Biomass and bioenergy.
- Wave and tide energy.
- Geothermal energy.
- Fuel flexibility and alternatives.
- Micro- and nano-energy systems and technologies.
- Hybrid / integrated energy systems.
- Energy conversion, conservation and management.
- Energy efficient buildings.
- Energy generation and energy storage.
- Energy modelling and prediction.
- Energy and sustainable development.
- Energy efficiency and sustainability inherent in heritage places.
- Fluid mechanics and thermodynamics, including CFD, heat transfer and combustion.
- Smart materials and structures.
- Materials for energy.

Environment

- Energy and environmental impact.
- Thermal, acoustic, visual, air quality building science and human impacts.
- Eco-design of energy-related products.
- Green electric and electronics.
- Solutions for mitigating environmental impacts and achieving low carbon, sustainable built environments.
- Technologies and integrated systems for high performance buildings and cities.
- Tools for the design and decision-making community, including tested computational, economic, educational and policy tools.
- Environment and sustainable development.
- Quality assurance / control.
- Emissions reduction.
- Waste management.
- Evaluation & management of environmental risk and safety.
- Advanced visualization techniques, virtual environments and prototyping.
- Water-related engineering issues.

A note to authors

Submission of articles

Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. The submitting author is responsible for obtaining agreement of all co-authors as well as any sponsors' required consent before submitting a paper. Responsibility for the content of a paper lays on the Authors and not on the Editors or the Publisher. All authors must complete the 'Journal Publishing Agreement' before the article can be published. Authors are encouraged to observe the guidelines in the preparation of their articles for submission to IJEE. Full instructions can be found on the journal homepage (<http://www.IJEE.IEEFoundation.org>).

Your Submitted Article

- Your article will be peer-reviewed and if accepted will be published very fast.
- Your biography will appear at the end of your article.
- Your article will be published free of charge. The Authors do not pay any kind of publication fees.
- Your article will be published around the world in full color. Free use of color where this enhances the article.
- Your article can be read by potentially millions of readers, which is incomparable to publishing in a traditional subscription journal. All interested readers can read, download, and/or print your article at no cost!
- Your article will obtain more citations.
- Moreover, all articles are indexed by the major indexing media therefore providing the maximum exposure to the articles.

INTERNATIONAL JOURNAL OF ENERGY AND ENVIRONMENT

Official Journal of the International Energy & Environment Foundation

Journal homepage: www.IJEE.IEEFoundation.org



Editor-in-Chief

Maher A.R. Sadiq Al-Bagdadi

President of the International Energy and Environment Foundation (IEEF), Najaf, P.O.Box. 39, Iraq.

Associate Editors

Hashim R. Abdol Hamid

*Environment Research Center, International Energy and Environment Foundation (IEEF), Najaf,
P.O.Box. 39, Iraq.*

Muhannad Al-Waily

*Applied Mechanics Research Center, International Energy and Environment Foundation (IEEF), Najaf,
P.O.Box. 39, Iraq.*

Editorial Advisory Board

Basim Ajeel Abass

Mechanical Engineering Department, College of Engineering, Babylon University, Babylon, Iraq .

Ramesh K. Agarwal

Washington University in St. Louis, 1 Brookings Drive, St. Louis, MO 63130, USA

Hayder Y. Ahmad

MIMechE, CEng, 81 Suffolk Road, Harrow, HA2 7QF, UK.

Kadim Karim Mohsen Ali

Materials Engineering Department, College of Engineering, University of Thi-Qar, Thi-Qar, Iraq.

Zaman Abud Almalik

Mechanical Engineering Department, Faculty of Engineering, University of Kufa, Najaf, Iraq .

Mohsin Abdullah A. Al-Shammari

College of Engineering, University of Baghdad, Baghdad, Iraq.

Amitava Bandyopadhyay

Department of Chemical Engineering, University of Calcutta, 92, A.P.C.Road, Kolkata 700 009, India.

Angelo Basile

Institute on Membrane Technology of the Italian National Research Council, ITM-CNR, c/o University of Calabria, via P. Bucci, cubo 17/C, 87030 Rende (CS), Italy.

Wojciech Budzianowski

Wroclaw University of Technology, ul. Wybrzeze Wyspianskiego 27, 50-370 Wroclaw, Poland.

Jumaa Salman Chiad

Prosthetic and Orthotic Engineering Department, College of Engineering, Al-Nahrain University, Baghdad, Iraq.

Ahmet Erklig

University of Gaziantep, Faculty of Engineering, Mechanical Engineering Department, 27310 Gaziantep, Turkey.

Evangelos G. Giakoumis

School of Mechanical Engineering, National Technical University of Athens, 9 Heron Polytechniou St., Zografou Campus, 15780, Athens, Greece.

Eloy Velasco Gomez

ETS Ingenieros Industriales, Universidad de Valladolid, Paseo del Cauce, no 59, 47011 Valladolid, Spain.

Abdul Kareem F. Hassan

College of Engineering, University of Basrah, Basrah, Iraq.

Ahmed M. Hasson

Mechanical Engineering Department, College of Engineering, Al-Nahrain University, Baghdad, Iraq.

Ihsan Y. Hussain

College of Engineering, University of Baghdad, Baghdad, Iraq.

Mahmud Rasheed Ismail

Prosthetic and Orthotic Engineering Department, College of Engineering, Al-Nahrain University, Baghdad, Iraq.

Muhsin Jweeg

Telafer University, College of Engineering, Iraq.

Arunachala Nadar Kannan

Department of Engineering Technology, TECH 156, Arizona State University, 7001 E Williams Field Rd, Mesa, AZ 85212, U.S.A.

T. Lu

School of Mechanical and Electrical Engineering, Beisanhuan East Road, Chaoyang District, Beijing 100029, P.R.China.

A. Mani

Refrigeration and Air-conditioning Laboratory,
Department of Mechanical Engineering, Indian Institute
of Technology Madras, Chennai 36, Pincode 600 036,
India.

Ameen Ahmed Nassar

College of Engineering, University of Basrah, Basrah,
Iraq.

Meng Ni

Department of Building and Real Estate, The Hong Kong
Polytechnic University, Hung Hom, Kowloon, Hong
Kong.

Jawad Kadhim Olewi

Materials Engineering Department, University of
Technology, Baghdad, Iraq.

S-J Park

Department of Chemistry, Inha University, 253
Yonghyun-dong, Nam-gu 402-751, Korea (south).

Andreas Poullikkas

Electricity Authority of Cyprus, 1399 Nicosia, Cyprus.

Md. Mujibur Rahman

Department of Mechanical Engineering, College of
Engineering, Universiti Tenaga Nasional, Km 7, Jalan
Kajang-Puchong, 43009 Kajang, Selangor, Malaysia.

Julien Ramousse

Polytech'Savoie, Université de Savoie, Campus
scientifique, Savoie Technolac, 73376 Le Bourget, du
Lac, CEDEX, France.

Teemu Rasanen

Research Group of Environmental Informatics,
Department of Environmental Sciences, University of
Kuopio, FI-70211 Kuopio, Finland.

Kadhim Kamil Resan

College of Engineering, Al-mustansiriyah University,
Baghdad, Iraq.

Marc A. Rosen

University of Ontario Institute of Technology, Faculty of
Engineering and Applied Science, 2000 Simcoe Street
North, Oshawa, Ontario, L1H 7K4, Canada.

David Michael Rowe

Cardiff School of Engineering, Queen's Buildings,
Newport Road Cardiff CF24 1XF, U.K.

Hisham M. Sabir

Kingston University, Faculty of Engineering, Friars
Avenue, London SW15 3DW, U.K.

Suresh Babu Sadineni

Center for Energy Research, Department of Mechanical
Engineering, Howard R. Hughes College of Engineering,
University of Nevada, Las Vegas (UNLV) 89154-4027,
U.S.A.

Bidyut Baran Saha

Department of Mechanical Engineering, National
University of Singapore, 9 Engineering Drive 1, 117576,
Singapore.

Vicente Salas

Department of Electronic Technology, Universidad Carlos
III de Madrid, Avda. de la Universidad, 30, 28911
Leganes, Madrid, Spain.

Amin U. Sarkar

School of Business, Alabama A&M University, Normal
(Huntsville), AL 35762, U.S.A.

Moinuddin Sarker

Natural State Research, Inc., 37 Brown House Road
(Second Floor), Stamford, CT-06902, USA.

Joop Schoonman

Department DelftChemTech: Materials for Energy
Conversion and Storage, Delft University of Technology,
Julianalaan 136, 2628 BL Delft, The Netherlands.

Tomonobu Senjyu

University of the Ryukyus, Faculty of Engineering, 1
Senbaru Nishihara-cho Nakagami Okinawa 903-0213,
Japan.

Jose Ramon Serrano

Universidad Politécnica de Valencia, CMT-Motores
Térmicos, Camino de Vera s/n, 46022 Valencia, Spain.

Haroun A.K. Shahad

Department of Mechanical Engineering, University of
Babylon, Babylon, Iraq

Rajnish N. Sharma

Department of Mechanical Engineering, University of
Auckland, Private Bag 92019, Auckland 1142, New
Zealand.

S.A. Sherif

HVAC Laboratory, Department of Mechanical and
Aerospace Engineering, University of Florida, 232 MAE
Bldg. B, Gainesville, Florida 32611-6300, U.S.A.

Shailendra Kumar Shukla

Department of Mechanical Engineering, Institute of
Technology, B.H.U., Varanasi-221005, India.

Rayan Slim

Center for Energy and Processes, Ecole des Mines de
Paris, 104 Bobillot Street, 75013 Paris, France.

Laizhou Song

Department of Environmental and Chemical Engineering,
Yanshan University, Qinhuangdao City, Hebei Province,
P.R.China.

Adnan Sozen

Department of Mechanical Education, Gazi University,
Technical Education Faculty 06500 Teknikokullar,
Ankara Turkey.

Roland Span

Lehrstuhl für Thermodynamik, Ruhr-University Bochum,
D-44780 Bochum, Germany.

Anurag K. Srivastava

Electrical and Computer Engineering, Mississippi State
University, 216 Simrall Hall, Hardy Road, Mississippi
State, MS 39762, U.S.A.

Rosetta Steeneveldt

Research Centre Trondheim, StatoilHydro, Arkitekt
Ebbells vei 10, N 7005 Trondheim, Norway.

Athina Stegou-Sagia

School of Mechanical Engineering, Department of
Thermal Engineering, National Technical University of
Athens, 9 Iroon Polytechniou Str. Zografou 157 80,
Athens, Greece.

Peter Stigson

School of Sustainable Development of Society and Technology, Mälardalen University, 721 23 Västerås, Sweden.

Anna Stoppato

Department of Mechanical Engineering, University of Padova, via Venezia, 1-35131 Padova, Italy.

Michael Stoukides

Department of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece.

Jian-Feng Sun

College of Food Science and Technology, Agricultural University of Hebei, Baoding City, Hebei Province, 071000 P.R.China.

Stanislaw Szwaja

Department of Engineering Mechanics, Michigan Technological University, 1400 Townsend Drive, Houghton, MI, 49931, U.S.A.

Ayad Murad Takak

Mechanical Engineering Department, College of Engineering, Al-Nahrain University, Baghdad, Iraq.

David S-K. Ting

Mechanical, Automotive & Materials Engineering, University of Windsor, Windsor, Ontario, N9B 3P4, Canada.

G. N. Tiwari

Centre for Energy Studies, Indian Institute of Technology Delhi, Hauz Khas, New Delhi - 110 016, India.

Bor-Jang Tsai

Department of Mechanical Engineering, Chung Hua University, No. 707, Sec. 2, Wu Fu Rd., Hsinchu 300, Taiwan.

Athanasios Tsolakis

School of Mechanical Engineering, University of Birmingham, Edgbaston, Birmingham, B15 2TT, U.K.

Per Tunestal

Department of Energy Sciences, Lund University, SE-221 00 Lund, Sweden.

Aynur Ucar

Department of Mechanical Engineering, Firat University, Elazig, Turkey.

Despina Vamvuka

Department of Mineral Resources Engineering, Technical University of Crete, University Campus, Hania 73100, Crete, Greece.

Virendra Kumar Vijay

Centre for Rural Development and Technology, Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110016, India.

Roberto Volpe

Faculty of Engineering and Architecture, Università degli Studi di Enna "Kore" Cittadella Universitaria, 94100 - Enna, Italy.

Shengwei Wang

Department of Building Services Engineering, The Hong Kong Polytechnic University, Hong Kong.

Yi-Ming Wei

Center for Energy and Environmental Policy Research (CEEP), Beijing Institute of Technology, No.5 South Zhongguancun Street, Haidian District, Beijing 100081, P.R.China.

Samantha Wijewardane

Laboratory for Advanced Materials, Science and Technology (LAMSAT), Department of Physics, University of South Florida, 4202 E. Fowler Ave., Tampa, FL 33620, USA.

Gwomei Wu

Chang Gung University, 259 Wen Hua 1st Road, Kweisan, Taoyuan 333, Taiwan.

Contents

Graphene nanosheets coating method as a new passive cooling alternative for printed-circuits board and microprocessor of laptops - CFD analysis study. <i>Maheer A.R. Sadiq Al-Baghdadi</i>	145-156
A first CFD study of small hydro energy recovery from the attica water supply network. <i>Alkistis Stergiopoulou, Vassilios Stergiopoulos</i>	157-166
Development of biogas resources and technologies in Ghana, a survey. <i>Edward A. Awafo, Victor K. Agyeman</i>	167-178
Geothermal Direct Use for Snapper Fishpond Heating at Yogyakarta. <i>Allen Haryanto Lukmana, Ria Ayu Rifani, Rahma Kumalaningtyas</i>	179-184
Surface modification of Ti 6Al4V alloy coated (HAp-collagen) by spin coating method. <i>Dunya Abdulsahib Hamdi, Abdul Rahman Najeem Abed</i>	185-189

ANNOUNCEMENTS - IEEF RELEASE

- BOOK: CFD Applications in Energy and Environment Sectors: Volume 1.**
Editors: Maheer A.R. Sadiq Al-Baghdadi and Hashim R. Abdol Hamid (ISBN 13: 978-1-46623-065-1)
- BOOK: Engineering Applications of Computational Fluid Dynamics: Volume 1.**
Editor: Maheer A.R. Sadiq Al-Baghdadi (ISBN 13: 978-1-46623-106-1)
- BOOK: CFD Modeling in Development of Renewable Energy Applications.**
Editor: Maheer A.R. Sadiq Al-Baghdadi (ISBN 13: 978-1-46623-131-3)
- BOOK: Engineering Applications of Computational Fluid Dynamics: Volume 2.**
Editor: Maheer A.R. Sadiq Al-Baghdadi (ISBN 13: 978-1-47832-935-0)
- BOOK: PEM Fuel Cells - Fundamentals, Modeling, and Applications.**
Author: Maheer A.R. Sadiq Al-Baghdadi (ISBN 13: 978-1-48197-823-1)
- BOOK: Alternative Fuels Research Progress.**
Editor: Maheer A.R. Sadiq Al-Baghdadi (ISBN 13: 978-1-48405-771-1)
- BOOK: Computational Fluid Dynamics Applications in Green Design.**
Editor: Maheer A.R. Sadiq Al-Baghdadi (ISBN 13: 978-1-49487-575-6)
- BOOK: Stress Redistribution in Composite Materials.**
Author: Luay S. Alansari (ISBN 13: 978-1-49730-742-1)
- BOOK: PEM Fuel Cells from Single Cell to Stack - Fundamental, Modeling, Analysis, and Applications.**
Author: Maheer A.R. Sadiq Al-Baghdadi (ISBN 13: 978-1-50588-564-4)
- BOOK: Dynamic Analysis Investigation of Stiffened and Un-Stiffened Composite Laminated Plate Subjected to Transient Loading.**
Author: Muhannad Al-Waily (ISBN 13: 978-1-50757-536-9)
- BOOK: Analytical and Numerical Buckling and Vibration Investigation of Isotropic**

and Orthotropic Hyper Composite Materials Structures.*Author: Muhanad Al-Waily**(ISBN 13: 978-1-50588-564-4)***BOOK: Engineering Applications of Computational Fluid Dynamics: Volume 3.***Editor: Maher A.R. Sadiq Al-Baghdadi**(ISBN 13: 978-1-51178-878-6)***BOOK: Engineering Applications of Computational Fluid Dynamics: Volume 4.***Editor: Maher A.R. Sadiq Al-Baghdadi**(ISBN 13: 978-1-51197-480-6)***BOOK: Applications of Computational Fluid Dynamics and Finite Element Methods in Engineering Education: Volume 1.***Author: Maher A.R. Sadiq Al-Baghdadi**(ISBN 13: 978-1-51212-242-8)***BOOK: Engineering Applications of Computational Fluid Dynamics: Volume 5.***Editor: Maher A.R. Sadiq Al-Baghdadi**(ISBN 13: 978-1-54035-259-0)***BOOK: Physical modeling of PIANO KEY weir: Detailed experimental study.***Author: Mohammed Baqer N. Al-Baghdadi**(ISBN 13: 978-1-53971-134-6)***BOOK: Analytical and Experimental Investigations Vibration Study of Isotropic and Orthotropic Composite Plate Structure with Various Crack Effect.***Author: Muhanad Al-Waily**(ISBN 13: 978-1-54403-151-4)***BOOK: Materials Science and Engineering.***Author: Noor Hussein**(ISBN 13: 978-1-54408-380-3)***BOOK: PEM Fuel Cell Engines: Principles, Design, Modelling, and Analysis.***Author: Maher A.R. Sadiq Al-Baghdadi**(ISBN 13: 978-1-98347-499-6)***BOOK: Progress in River Engineering & Hydraulic Structures: Volume 1.***Editor: Mohammed Baqer N. Al-Baghdadi**(ISBN 13: 978-1-98520-206-1)***BOOK: Progress in River Engineering & Hydraulic Structures: Volume 2.***Editor: Mohammed Baqer N. Al-Baghdadi**(ISBN 13: 978-1-72759-365-5)*