The International Journal of Hydrogen Energy aims to provide a central vehicle for the exchange and dissemination of new ideas, technology developments and research results in the field of Hydrogen Energy between scientists and engineers throughout the world. The emphasis is placed on original research, both analytical and experimental, covering all aspects of Hydrogen Energy, including production, storage, transmission, utilization, enabling technologies, environmental impact, economic and international aspects of hydrogen and hydrogen carriers such as NH3, CH4, alcohols, etc.

The utilization includes thermochemical (combustion), photochemical, electrochemical (fuel cells) and nuclear conversion of hydrogen, hydrogen isotopes and/or hydrogen carriers to thermal, mechanical and electrical energies, and their applications in transportation (including aerospace), industrial, commercial and residential sectors.

When outstanding new advances are made, or when new areas have been developed to a definitive stage, special review articles will be considered. Shorter communications are also welcome.

Energy researchers, engineering students, environmentalists, chemists, energy companies.

2018: 4.084 © Clarivate Analytics Journal Citation Reports 2019
ABSTRACTING AND INDEXING

Current Contents
Environmental Periodicals Bibliography
Chemical Abstracts
Engineering Index
Scopus
Chimica
Energy & Power Source
Environment Complete
Environment Index
Chemical Engineering Biotechnology Abstracts
COMPENDEX
Current Abstracts
Engineering Information Database EnCompass LIT (Elsevier)
International Building Services Abstracts
INSPEC
PubMed/Medline
Referativnyi Zhurnal VINTI-RAN (Russian Academy of Sciences)
Russian Academy of Sciences
Science Citation Index Expanded
TEMA - Technik und Management
Web of Science
Current Abstracts (EBSCO)
TOC Premier
Engineering Index Monthly
OCLC Contents Alert

EDITORIAL BOARD

Founding Editor-in-Chief
T. Nejat Veziroglu, International Assoc Hydro Eng, Coral Gables, Florida, United States

Editor-in-Chief
Emre A. Veziroglu

Senior Associate Editor
John W. Sheffield, Purdue University, 401 N Grant St., West Lafayette, IN 47907-2021, U.S.A

Associate Editors
Suleyman Allakhverdiev, Russian Academy of Sciences, Moscow, Russian Federation
Angelo Basile, Inst. on Membrane Technology of Italian Nat. Res. Council, ITM-CNR, Rende (CS), Italy AST Engineering spa, Rome, Italy
Fanglin (Frank) Chen, University of South Carolina, Columbia, South Carolina, United States
Ibrahim Dincer, University of Ontario Institute of Technology, Department of Mechanical Engineering, Ontario, Canada
E. Caglan Kumbur, Drexel University, Philadelphia, Pennsylvania, United States
Nazim Z. Muradov, University of Central Florida Cocoa Campus, Cocoa, Florida, United States
Arunachalanadar M. Kannan, Arizona State University, Ira A. Fulton School of Engineering, Mesa, Arizona, United States

Assistant Editors
Andreasen, Serenergy A/S, Aalborg University, Aalborg, Denmark
Umit B. Demirci, University of Montpellier, Montpellier, France
Fausto Gallucci, University of Technology Eindhoven, Eindhoven, Netherlands
Alfredo Iranzo, University of Seville, Sevilla, Spain
Umit. O. Koylu, Missouri University of Science and Technology, Rolla, Missouri, United States
Mohammad Mahdi Najafpour, Institute for Advanced Studies in Basic Sciences, Zanjan, Iran, Islamic Republic of
Vicenzo Palma, University of Salerno, Fisciano, Italy
Ramazan Solmaz, Bingol University, Bingol, Turkey
Shohji Tsushima, Osaka University, Suita, Japan
Alexander Vorontsov, Altai State University, Barnaul, Russian Federation
Assistant Subject Editors
Duha Ahmed, University of Technology, Baghdad, Iraq
Sadia Ameen, Chonbuk National University, Jeonju, Republic of Korea
Yasser Ashraf Gandomi, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, Massachusetts, United States
Amlan Chakraborty, Entegris Inc, Franklin, MA, United States
Chin Kui Cheng, Universiti Malaysia Pahang (UMP), Faculty of Chemical & Natural Resources Engineering, Pahang, Malaysia
Arunabha Kundu, Carrollton, KY 41008, United States
Justo Lobato, University of Castilla-La Mancha, Ciudad Real, Spain
Dai-Viet N. Vo, Universiti Malaysia Pahang (UMP), Faculty of Chemical & Natural Resources Engineering, Pahang, Malaysia
Ahsan-Ul-Haq Qurashi, King Fahd University of Petroleum & Minerals, Al Dhahran, Saudi Arabia
Mehran Rezaei, School of Chemical, Petroleum and Gas Engineering, Iran University of Science and Technology, Tehran, Iran, Islamic Republic of
Bahman Shabani, RMIT University, Mechanical and Automotive Engineering Discipline, Bundooloo, Australia
Armen Tchounian, Yerevan State University, Yerevan, Armenia
Xia Wei, ZPower LLC, Camarillo, California, United States
Junmin Yan, Jilin University, Changchun, China
Renju Zacharia, Great Wall Motors, Hydrogen Storage and Infrastructure Testing, Baoding, Hebei, China

Financial Manager
Ayfer Veziroglu

Editorial Board
Sukhvinder Badwal, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Energy Technology, Clayton South, Victoria, Australia
Sema Baykara, Yildiz Technical University, Istanbul, Turkey
Mohamed Bououdina, University of Bahrain, Sakhir, Bahrain
Ping Cheng, Shanghai Jiao Tong University, Shanghai, China
Debabrata Das, Indian Institute of Technology Madras, Chennai, India
Annew Dicks, University of Queensland, Brisbane, Australia
 Nedjib Djilali, University of Victoria, Victoria, British Columbia, Canada
Jürgen Garche, ZSW Ctr Solar Energy & Hyd Res, Ulm, Germany
Li-jin Guo, Xi’an Jiaotong University, School of Energy & Power Engineering, Shaanxi, China
Ziya Guvenc, Cankaya University, Ankara, Turkey
Kevin Kendall, University of Birmingham, Birmingham, United Kingdom
John Kilner, Imperial College London Department of Materials, London, United Kingdom
Chang-Soo Kim, Korea Institute of Energy Research, Daejeon, Republic of Korea
Xianguo Li, University of Waterloo, Waterloo, Ontario, Canada
Hongtan Liu, University of Miami, Coral Gables, Florida, United States
Ke Liu, Hydrogensource LLC/UTC, Fuel Cells, South Windsor, United States
Stanislav Malyschenko, Russian Academy of Sciences, Moscow, Russian Federation
Arnold Miller, Vehicle Projects Inc., Golden, Colorado, United States
Janusz Nowotny, University of New South Wales, Sydney, Australia
Ken-ichiro Ota, Yokohama National University, Yokohama, Japan
Bruno Pollet, Norwegian University of Science and Technology, Trondheim, Norway
Tom R. Ralph, Johnson Matthey Plc, Reading, United Kingdom
Nigel Sammes, Connecticut Global Fuel Cell Center, Storrs, Connecticut, United States
Ernesto Santibanez Gonzalez, Federal University of Bahia, Centro de Formação em Ciências Ambientais (CFCAm), Porto Seguro, Brazil
Oumarou Savadogo, Montreal Polytechnic, Montreal, Quebec, Canada
Keith Scott, Newcastle University, Newcastle Upon Tyne, United Kingdom
P Joseph Sebastian, Universidad Nacional Autónoma de México (UNAM), Instituto de Energías Renovables (IER), Temixco, Morelos, Mexico
Manish Sinha, Fuel Cell Activities, General Motors, Honeoye Falls, New York, United States
Onkar Nath Srivastava, Banaras Hindu University, Varanasi, India
Ali T-Raissi, University of Central Florida Cocoa Campus, Cocoa, Florida, United States
Hiroshisa Uchida, Tokai University, Dept. of Nuclear Engineering, Kanagawa, Japan
Oystein Ulleberg, Institute for Energy Technology, Kjeller, Norway
Francisco Uribe, Los Alamos National Laboratory, Los Alamos, New Mexico, United States
John Van Zee, University of South Carolina, Columbia, South Carolina, United States
Chao-Yang Wang, Pennsylvania State University, University Park, Pennsylvania, United States
Yuda Yurum, Sabanci University, Istanbul, Turkey

Emeritus Editors
F. Barbir, University of Split, Split, Croatia
M.B. Gorensek, Savannah River National Laboratory, Aiken, South Carolina, United States  
M.M. Mench, University of Tennessee, Knoxville, Tennessee, United States  
S. A. Sherif, University of Florida Department of Mechanical and Aerospace Engineering, Gainesville, Florida, United States

Honorary Editorial Board

Hussein Abdel-Aal, H.I.T., Chemical Engineering, Cairo, Egypt  
Luis Avaca, Universidade de São Paulo (USP), Inst. de Fisica e Quimica, Sao Carlos, Brazil  
Roger Billings, Energy Innovations, Independence, Maryland, United States  
David Block, Florida Solar Energy Center, Cocoa, Florida, United States  
William Escher, Madison, AL 35758-6614, USA  
Daniel Fruchart, NÉEL Institute, Grenoble, France  
Victor A. Goltsov, Donetsk National Technical University, Donetsk, Ukraine  
Derek P. Gregory, University of Glasgow, Glasgow, United Kingdom  
Sadik Kakac, Middle East Technical University, Ankara, Turkey  
Ghazi A. Karim, University of Calgary, Calgary, Alberta, Canada  
Peter Lehman, Humboldt State University, Arcata, California, United States  
F. A. Lewis, Queen’s University Belfast, Belfast, United Kingdom  
Cesare Marchetti, International Institute for Applied Systems Analysis, Laxenburg, Austria  
Jean Pottier, Gaz De France, Direction Etudes Techniq Nouve, St Denis, France  
David S. Scott  
Walter Seifritz, CH 2512 Hausen, Switzerland  
Meyer Steinberg, Brookhaven National Laboratory, Upton, Long Island, NY 11973-5000  
Patrick Takahashi, University of Hawai’i at Manoa, Honolulu, Hawaii, United States  
William D. Van Vorst, Pacific Palisades, CA 90272-2819 USA  
Hugo Vandenborre, Vandenborre Technologies NV, Oevel, Belgium  
Ashok Vijh, Research Institute of Hydro-Quebec, IREQ, Québec, Quebec, Canada  
Carl-Jochen Winter, DFVLR, Stuttgart, Germany  
Sümer Şahin, Near East University, Faculty of Engineering, Turkish Republic of Northern Cyprus, Lefkoşa/KKTC
GUIDE FOR AUTHORS

Your Paper Your Way
We now differentiate between the requirements for new and revised submissions. You may choose to submit your manuscript as a single Word or PDF file to be used in the refereeing process. Only when your paper is at the revision stage, will you be requested to put your paper in to a 'correct format' for acceptance and provide the items required for the publication of your article.

To find out more, please visit the Preparation section below.

INTRODUCTION

Types of Paper
The International Journal of Hydrogen Energy accepts research papers, review papers and short communications.

Research papers:
• A research paper presents the results of investigations on a relevant subject matter.
• The length should not normally exceed 8000 words and 12 diagrams - this corresponds to approximately 12 journal pages.
• Guide for Authors should be followed.

Review Papers:
• A review paper succinctly reviews recent progress on a specific subject of active research. It should summarize the current state of knowledge of the topic by discussing the findings presented in recent research papers.
• The length should not normally exceed 12000 words and 20 diagrams - this corresponds to approximately 18 journal pages.
• Guide for Authors should be followed.

Short communications:
• A short communication informs the scientific community about recent research, which the authors wish to publish as quickly as possible, without writing a detailed full length research paper.
• The length should not normally exceed 3000 words and 4 diagrams - this corresponds to approximately 4 journal pages.
• Guide for Authors should be followed.

Submission checklist
You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:
• E-mail address
• Full postal address

All necessary files have been uploaded:
Manuscript:
• Include keywords
• All figures (include relevant captions)
• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print

Graphical Abstracts / Highlights files (where applicable)
Supplemental files (where applicable)

Further considerations
• Manuscript has been 'spell checked' and 'grammar checked'
• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)
• A competing interests statement is provided, even if the authors have no competing interests to declare
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

BEFORE YOU BEGIN

Ethics in Publishing
It is not permissible for author(s) to simultaneously submit essentially the same manuscript to the IJHE and other journal(s). Plagiarism in any form will not be tolerated. The submission of a multi-authored manuscript by a corresponding author implies that all co-authors had made significant contributions to the work.
For information on Ethics in Publishing and Ethical guidelines for journal publication see https://www.elsevier.com/publishingethics and https://www.elsevier.com/ethicalguidelines.

Studies in humans and animals
If the work involves the use of human subjects, the author should ensure that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. The manuscript should be in line with the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals and aim for the inclusion of representative human populations (sex, age and ethnicity) as per those recommendations. The terms sex and gender should be used correctly.

Authors should include a statement in the manuscript that informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed.

All animal experiments should comply with the ARRIVE guidelines and should be carried out in accordance with the U.K. Animals (Scientific Procedures) Act, 1986 and associated guidelines, EU Directive 2010/63/EU for animal experiments, or the National Institutes of Health guide for the care and use of Laboratory animals (NIH Publications No. 8023, revised 1978) and the authors should clearly indicate in the manuscript that such guidelines have been followed. The sex of animals must be indicated, and where appropriate, the influence (or association) of sex on the results of the study.

Declaration of interest
All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential competing interests include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors must disclose any interests in two places: 1. A summary declaration of interest statement in the title page file (if double-blind) or the manuscript file (if single-blind). If there are no interests to declare then please state this: 'Declarations of interest: none'. This summary statement will be ultimately published if the article is accepted. 2. Detailed disclosures as part of a separate Declaration of Interest form, which forms part of the journal's official records. It is important for potential interests to be declared in both places and that the information matches. More information.

Submission declaration and verification
Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), 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. To verify originality, your article may be checked by the originality detection service Crossref Similarity Check.

Preprints
Please note that preprints can be shared anywhere at any time, in line with Elsevier's sharing policy. Sharing your preprints e.g. on a preprint server will not count as prior publication (see 'Multiple, redundant or concurrent publication' for more information).
Use of inclusive language
Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Articles should make no assumptions about the beliefs or commitments of any reader, should contain nothing which might imply that one individual is superior to another on the grounds of race, sex, culture or any other characteristic, and should use inclusive language throughout. Authors should ensure that writing is free from bias, for instance by using 'he or she', 'his/her' instead of 'he' or 'his', and by making use of job titles that are free of stereotyping (e.g. 'chairperson' instead of 'chairman' and 'flight attendant' instead of 'stewardess').

Changes to authorship
Authors are expected to consider carefully the list and order of authors before submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only before the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the corresponding author: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed. The Editor will not consider the addition, deletion or rearrangement of authors after the manuscript has been accepted.

Copyright
Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete an 'Exclusive License Agreement' (more information). Permitted third party reuse of gold open access articles is determined by the author's choice of user license.

Author rights
As an author you (or your employer or institution) have certain rights to reuse your work. More information.

Elsevier supports responsible sharing
Find out how you can share your research published in Elsevier journals.

Role of the funding source
You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

Funding body agreements and policies
Elsevier has established a number of agreements with funding bodies which allow authors to comply with their funder's open access policies. Some funding bodies will reimburse the author for the gold open access publication fee. Details of existing agreements are available online.

Open access
This journal offers authors a choice in publishing their research:

Subscription
• Articles are made available to subscribers as well as developing countries and patient groups through our universal access programs.
• No open access publication fee payable by authors.
• The Author is entitled to post the accepted manuscript in their institution's repository and make this public after an embargo period (known as green Open Access). The published journal article cannot be shared publicly, for example on ResearchGate or Academia.edu, to ensure the sustainability of peer-reviewed research in journal publications. The embargo period for this journal can be found below.

**Gold open access**
• Articles are freely available to both subscribers and the wider public with permitted reuse.
• A gold open access publication fee is payable by authors or on their behalf, e.g. by their research funder or institution.

Regardless of how you choose to publish your article, the journal will apply the same peer review criteria and acceptance standards.

For gold open access articles, permitted third party (re)use is defined by the following Creative Commons user licenses:

*Creative Commons Attribution (CC BY)*
Lets others distribute and copy the article, create extracts, abstracts, and other revised versions, adaptations or derivative works of or from an article (such as a translation), include in a collective work (such as an anthology), text or data mine the article, even for commercial purposes, as long as they credit the author(s), do not represent the author as endorsing their adaptation of the article, and do not modify the article in such a way as to damage the author's honor or reputation.

*Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)*
For non-commercial purposes, lets others distribute and copy the article, and to include in a collective work (such as an anthology), as long as they credit the author(s) and provided they do not alter or modify the article.

The gold open access publication fee for this journal is **USD 2750**, excluding taxes. Learn more about Elsevier's pricing policy: [https://www.elsevier.com/openaccesspricing](https://www.elsevier.com/openaccesspricing).

**Green open access**
Authors can share their research in a variety of different ways and Elsevier has a number of green open access options available. We recommend authors see our open access page for further information. Authors can also self-archive their manuscripts immediately and enable public access from their institution's repository after an embargo period. This is the version that has been accepted for publication and which typically includes author-incorporated changes suggested during submission, peer review and in editor-author communications. Embargo period: For subscription articles, an appropriate amount of time is needed for journals to deliver value to subscribing customers before an article becomes freely available to the public. This is the embargo period and it begins from the date the article is formally published online in its final and fully citable form. Find out more.

This journal has an embargo period of 24 months.

**Language (usage and editing services)**
Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's WebShop.

**Full Online Submission**
Submission to this journal proceeds totally online. Use the following guidelines to prepare your article. Via the homepage of this journal ([http://ees.elsevier.com/he](http://ees.elsevier.com/he)) you will be guided stepwise through the creation and uploading of the various files. The system automatically converts source files to a single Adobe Acrobat PDF version of the article, which is used in the peer-review process. Please note that even though manuscript source files are converted to PDF at submission for the review process, these source files are needed for further processing after acceptance. All correspondence, including notification of the Editor's decision and requests for revision, takes place by e-mail and via the author's homepage, removing the need for a hard-copy paper trail.

**Referees**
Please submit the names and institutional e-mail addresses of several potential referees. For more details, visit our Support site. Note that the editor retains the sole right to decide whether or not the suggested reviewers are used.
**PREPARATION**

**NEW SUBMISSIONS**
Submission to this journal proceeds totally online and you will be guided stepwise through the creation and uploading of your files. The system automatically converts your files to a single PDF file, which is used in the peer-review process.

As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or layout that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

**References**
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

**Formatting requirements**
There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions.

If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes.

Divide the article into clearly defined sections.

**Figures and tables embedded in text**
Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. The corresponding caption should be placed directly below the figure or table.

**Peer review**
This journal operates a single blind review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. More information on types of peer review.

**REVISED SUBMISSIONS**

**Marked Copy**
Please supply a marked copy of the previous version of the manuscript highlighting the changes. This is in addition to a CLEAN, Unmarked copy of the final version.

**Use of word processing software**
Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

**LaTeX**
You are recommended to use the Elsevier article class elsarticle.cls to prepare your manuscript and BibTeX to generate your bibliography.

Our LaTeX site has detailed submission instructions, templates and other information.

**Article structure**

**Essential title page information**

**Title.** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
Author names and affiliations. Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name, and, if available, the e-mail address of each author. Corresponding author. Clearly indicate who is willing to handle correspondence at all stages of refereeing and publication, also post-publication. Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address.

Present/permanent address. If an author has moved since the work described in the article was done, or was visiting at the time, a "Present address" (or "Permanent address") may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract
A concise and factual abstract is required. The abstract should be written in the present tense and be no longer than 150 words maximum. It should briefly state the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Graphical Abstract
Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 1328 pixels (h w) or proportionally more. The image should be readable at a size of 5 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site.

Highlights
Highlights are mandatory for this journal. Highlights should describe the essence of the research, highlighting what is 'new' and distinctive about it. They must consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters per bullet point including spaces). See Elsevier Research Highlights for examples.

Keywords
Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, "and", "of"). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Subdivision - numbered sections
Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction
The introduction should define clearly the nature of the problem being considered. Reference should be made to previously published pertinent papers, accenting the major original contributions.

Material and methods
Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.
Theory/calculation
A Theory section should extend, not repeat, the background to the article already dealt with in the
Introduction and lay the foundation for further work. In contrast, a Calculation section represents a
practical development from a theoretical basis.

Results
Results should be clear and concise.

Discussion
This should explore the significance of the results of the work, not repeat them. A combined Results
and Discussion section is often appropriate. Avoid extensive citations and discussion of published
literature.

Conclusions
The main conclusions of the study should be presented in a short Conclusions section.

Appendices
If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in
appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix,
Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Highlights
Highlights are mandatory for this journal. They consist of a short collection of bullet points that
convey the core findings of the article and should be submitted in a separate editable file in the
online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points
(maximum 85 characters, including spaces, per bullet point). You can view example Highlights on
our information site.

Abbreviations
Define abbreviations that are not standard in this field in a footnote to be placed on the first page
of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first
mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

Acknowledgements
Collate acknowledgements in a separate section at the end of the article before the references and do
not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those
individuals who provided help during the research (e.g., providing language help, writing assistance
or proof reading the article, etc.).

Formatting of funding sources
List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy];
the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes
of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When
funding is from a block grant or other resources available to a university, college, or other research
institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or
not-for-profit sectors.

Nomenclature and units
Follow internationally accepted rules and conventions: use the international system of units (SI).
If other quantities are mentioned, give their equivalent in SI. You are urged to consult IUPAC:
Math formulae
Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Footnotes
Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article.

Artwork
Electronic artwork
General points
• Make sure you use uniform lettering and sizing of your original artwork.
• Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Indicate per figure if it is a single, 1.5 or 2-column fitting image.
• For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
• Please note that individual figure files larger than 10 MB must be provided in separate source files. A detailed guide on electronic artwork is available.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats
Regardless of the application used, when your electronic artwork is finalized, please 'save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):
EPS (or PDF): Vector drawings. Embed the font or save the text as 'graphics'.
TIFF (or JPG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi.
TIFF (or JPG): Bitmapped line drawings: use a minimum of 1000 dpi.
TIFF (or JPG): Combinations bitmapped line/half-tone (color or grayscale): a minimum of 500 dpi is required.

Please do not:
• Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); the resolution is too low.
• Supply files that are too low in resolution.
• Submit graphics that are disproportionately large for the content.

Color artwork
Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article. Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Figure captions
Ensure that each illustration has a caption. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables
Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

References
Citation in text
Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Web references
As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references
This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue
Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software
Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley. Using citation plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. More information on how to remove field codes from different reference management software.

Users of Mendeley Desktop can easily install the reference style for this journal by clicking the following link:
http://open.mendeley.com/use-citation-style/international-journal-of-hydrogen-energy
When preparing your manuscript, you will then be able to select this style using the Mendeley plug-ins for Microsoft Word or LibreOffice.

Reference formatting
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style
Text: Indicate references by number(s) in square brackets in line with the text. The actual authors can be referred to, but the reference number(s) must always be given.

List: Number the references (numbers in square brackets) in the list in the order in which they appear in the text.

Examples:
Reference to a journal publication:
Reference to a journal publication with an article number:
Reference to a book:

Reference to a chapter in an edited book:

Reference to a website:

Reference to a dataset:

Note shortened form for last page number. e.g., 51–9, and that for more than 6 authors the first 6 should be listed followed by 'et al.' For further details you are referred to 'Uniform Requirements for Manuscripts submitted to Biomedical Journals' (J Am Med Assoc 1997;277:927–34) (see also Samples of Formatted References).

Journal abbreviations source
Journal names should be abbreviated according to the List of Title Word Abbreviations.

Video
Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the file in one of our recommended file formats with a preferred maximum size of 150 MB per file, 1 GB in total. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages. Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

Data visualization
Include interactive data visualizations in your publication and let your readers interact and engage more closely with your research. Follow the instructions here to find out about available data visualization options and how to include them with your article.

Supplementary material
Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

Research data
This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.
Data linking
If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

Mendeley Data
This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. During the submission process, after uploading your manuscript, you will have the opportunity to upload your relevant datasets directly to Mendeley Data. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the Mendeley Data for journals page.

Data in Brief
You have the option of converting any or all parts of your supplementary or additional raw data into one or multiple data articles, a new kind of article that houses and describes your data. Data articles ensure that your data is actively reviewed, curated, formatted, indexed, given a DOI and publicly available to all upon publication. You are encouraged to submit your article for Data in Brief as an additional item directly alongside the revised version of your manuscript. If your research article is accepted, your data article will automatically be transferred over to Data in Brief where it will be editorially reviewed and published in the open access data journal, Data in Brief. Please note an open access fee of 600 USD is payable for publication in Data in Brief. Full details can be found on the Data in Brief website. Please use this template to write your Data in Brief.

MethodsX
You have the option of converting relevant protocols and methods into one or multiple MethodsX articles, a new kind of article that describes the details of customized research methods. Many researchers spend a significant amount of time on developing methods to fit their specific needs or setting, but often without getting credit for this part of their work. MethodsX, an open access journal, now publishes this information in order to make it searchable, peer reviewed, citable and reproducible. Authors are encouraged to submit their MethodsX article as an additional item directly alongside the revised version of their manuscript. If your research article is accepted, your methods article will automatically be transferred over to MethodsX where it will be editorially reviewed. Please note an open access fee is payable for publication in MethodsX. Full details can be found on the MethodsX website. Please use this template to prepare your MethodsX article.

Data statement
To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Statement page.

AFTER ACCEPTANCE
**Online proof correction**

Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.

If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.

We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

**Offprints**

The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order offprints at any time via Elsevier's Webshop. Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

**AUTHOR INQUIRIES**

Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch. You can also check the status of your submitted article or find out when your accepted article will be published.