



Materials Challenges in Alternative & Renewable Energy (MCARE 2015) is a premium conference on energy challenges from materials perspective. The meeting is organized by the Korean Institute of Chemical Engineers (KICHE) and The American Ceramic Society (ACerS). **MCARE 2015** is a premium forum addressing emerging materials technologies and emphasizing the future challenges in achieving a cleaner and sustainable global society. This top-of-the-line conference builds on the success of four previous conferences held in 2008, 2010, 2012 and 2014 in the United States.

MCARE 2015 will bring together leading global experts from industry, universities, R & D laboratories and government agencies, thus providing a unique opportunity for communication and collaboration essential to propel a multi-disciplinary dialogue on innovative and sustainable solutions in the field of alternative and renewable energy. This cutting-edge international conference will feature plenary and invited talks, thematically focused technical sessions and poster presentations enabling the delegates to network and exchange ideas with their professional peers and acclaimed experts.

MCARE 2015 will appeal to academic and industrial scientists working on energy challenges. It emphasizes the participation of students and early stage researchers and features a student poster contest and at least one other student-designed event. In addition, special activities for young professionals and interested participants are planned to enhance the awareness on materials challenges in alternative and renewable energy sources.

The scientific and technical scope of the meeting is to present new advances and research results in the fields of materials, energy, and environment technologies.

MCARE 2015 Chairs:

Yoon-Bong Hahn, Chonbuk National University, Korea
Sanjay Mathur, University of Cologne, Germany

Co-Chairs:

Shi-Woo Rhee, POSTECH, Korea
Taek-Soo Kim, KITECH, Korea
Hua-Tay Lin, Oak Ridge National Lab, USA

Secretary General:

Do-Heyoung Kim, Chonnam National University, Korea

Important Date

June 15 ~ September 24, 2014	Abstract submission
July 15 ~ December 15, 2014	Early registration
October 15, 2014	Notification of accepted abstracts
December 30, 2014	Announcement of final program (session the abstracts)
January 2 ~ 6, 2015	Attendance confirmation for on-site participants
March 1, 2015	Manuscript submission for publication in SCI journals
February 24 ~ 27, 2015	MCARE 2015 Conference

- **MCARE2015 Homepage:** <http://www.mcare2015.org>

Symposia at a Glance

Abstracts are solicited from interested and committed individuals from academia, national laboratories, industries and start-up companies on the following and related topics:

(Symposium 1) Hydrogen Energy - Water Splitting and Energy Application

Recently, hydrogen generation has attracted much attention because of its importance in green energy development. Hydrogen production from water splitting has been driven strongly because it uses only earth-abundant water and solar energy without generating pollutants. Various methods have been developed for solar water splitting, including photoelectrochemical (PEC) cell, photocatalytic water splitting, solar cell based method and etc. This special session will bring experts together from the different fields of state-of-art technologies of solar water splitting, which will foster the scientific exchange. This symposium will welcome contributed papers related to the following topics (but not limited to):

- Photoelectrochemical (PEC) solar water splitting
- Solar cell based water splitting
- Photocatalytic water splitting
- Artificial leaf system of hydrogen generation
- New system and material for water splitting
- Materials for hydrogen generation
- Catalysts for water splitting

Symposium Organizers:

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Yat Li (UC Santa Clara, USA), E-mail: yatli@ucsc.edu

(Symposium 2) Solar Power and Concentrators

Direct production of fuels from solar energy represents the most prominent and promising avenue for sustainable energy solutions derived from regenerative primary energy sources. Concentrating solar power is a technology that concentrates sunlight from a large field into a smaller area by using arrays of mirrors and uses the concentrated light or heat to operate power cycle or other heat engine. Much of the emphasis in this symposium will be laid on the large scale development of the concentration system from a scale-up perspective. Some of the topics for the symposium are:

- Development of parabolic and enclosed trough
- Research on Fresnel reflector
- Efficiency of light manipulation for solar power concentrators
- Solar power tower: construction and system management

Symposium Organizers:

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(Symposium 3) Materials Challenges in Fuel Cells

Fuel cells technologies have attracted much attention because of visions of the future related to the Energy Sustainability. Various kinds of fuel cell are being produced annually and sold commercially in a wide range of applications. However, continued research in both fundamental and applied will be essential to help reduce production costs and increase durability. This symposium will bring together leading researchers and technologists, working in critical areas such as new materials, degradation processes and systems engineering, to discuss the state-of-the-art, highlight new developments in fuel cells technologies. Some of the topics for the symposium are:

- Materials, Cell Components & Stacks for Proton Exchange Membrane Fuel Cells (PEMFC)
- Materials, Cell Components & Stacks for Solid Oxide Fuel Cells (SOFC)
- Materials, Cell Components & Stacks for Other Fuel Cells (MCFC, DMFC, Electrolyzers, Hydrogen Pump)
- Material Modeling, Process Modeling & Control for Fuel Cells

- Fuels, Fuel Processing, Infrastructures for Fuel Cells

Symposium Organizers:

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(Symposium 4) Materials for Next Generation Photovoltaics - Perovskite, Chalcopyrite, Graphene

Photovoltaic solar cell technologies have attracted attention because of clean renewable energy and promising alternative to fossil fuel energy. High-efficiency and low-cost are both keys to activate and enlarge the photovoltaic market. Thus, the most desirable direction is to develop a low-cost and high efficiency solar cell. Toward this common purpose, diverse technologies have been developed with organic and/or inorganic materials. This session 4 covers the recent progresses in photovoltaic technologies including perovskite solar cells, dye-sensitized solar cells, CIGS and CZTS solar cells, organic polymer solar cells, and silicon solar cells. Some of the topics for the symposium are:

- Materials and Structures for Perovskite Solar Cells
- Nanostructures, Materials and Electrochemistry for Dye-Sensitized Solar Cells
- Materials and Fabrication Process for CIGS and Thin Film Solar Cells
- Solution Process Based Organic Solar Cells
- Structured Materials for High Efficiency Si Solar Cells

Symposium Organizers:

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(Symposium 5) Self-Power Generators

This symposium will aim at fundamental understandings and practical development of the mechanical/thermal energy-harvesting strategies, micro/nanometer-scale piezoelectric/triboelectric/thermoelectric effect, and the coupling between piezoelectric potential and semiconductor behavior and functionalities. Abstracts on the theoretical and experimental study of piezoelectric, ferroelectric, triboelectric and thermoelectric nanomaterial development; systematic design and optimization of nanogenerators for self-powered electronics; and coupling effect between piezoelectric or ferroelectric polarization and

semiconducting properties including electronic band structure, optoelectronics, photovoltaics, thermoelectrics, catalysts, photoelectrochemistry, etc are greatly welcome. Some of the topics for the symposium are:

- **Materials and Devices for Piezoelectric, Triboelectric, Thermoelectric Power Generators**
- **Piezoelectric and ferroelectric nanomaterial synthesis, characterization, and integration**
- **Theoretical and experimental study on nanoscale mechanical/thermal-to-electric energy conversion process**
- **Fundamental study on band-structure engineering based on piezoelectric or ferroelectric polarization**
- **Hybrid energy-harvesting techniques (mechanical, thermal, solar, etc.)**

Symposium Organizers:

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(Symposium 6) Batteries and Energy Storage

Batteries are devices that convert chemical energy into electrical energy. There are many types of batteries available, representing a multi-billion dollar industry. The state-of-the-art electrical energy storage systems are not able to meet the requirements for energy-efficient use in transportation, grid and commercial technologies. Battery technology seeks new concepts in materials design to overcome the current limitations of performance and lifetime. More critical insight is required to both in terms of material structures as well as interfacial reactions to produce next-generation electrode materials and battery cells enabling higher energy densities and longer cycling abilities. The Batteries and Energy Storage Systems track will explore novel energy storage materials and technologies that are critical in making the current energy systems more effective in the future. Some of the topics for the symposium are:

- **New cell chemistries (cathode, anode, electrolyte and electrolyte additives) of lithium-ion batteries**
- **Power and capacity fade mechanism of lithium-ion batteries**
- **Sodium batteries (cathode, anode, electrolyte and electrolyte additives)**
- **Li-sulfur systems**
- **Li-oxygen systems**
- **Magnesium systems**
- **Redox and flow nonaqueous**
- **Interfaces and diagnostic challenges**
- **Safety matters**

Symposium Organizers:

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(Symposium 7) Materials Challenges in Nuclear Energy

The focus of this symposium will be on advance materials for safe and sustainable nuclear energy production and use. Key advantage of nuclear energy is that there are no greenhouse gas emissions. The symposium will include topics related to fission and fusion reactors. With the advent of new reactor concepts, there is a significant challenge for development of advanced materials to meet the stringent requirements. Thus, a systematic approach of modeling, processing, characterization, and in-service performance testing is required to bring new materials in use. This symposium will provide a forum for the global experts in diverse areas of materials for nuclear energy to discuss recent progress in the field. Some of the topics for the symposium are:

- Modeling and simulations of structural materials
- High temperature metals and alloys
- Advanced ceramic composites
- Characterization of materials and non-destructive evaluations
- Material performance in radiation environments
- Degradation mechanisms and lifetime predictions of material components
- Material behavior in severe (accident) environments
- Heat transfer materials and coolants
- Materials for radioactive waste containment and disposal

Symposium Organizers:

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(Symposium 8) Critical Materials for Energy

This symposium will focus on rare earths and other critical materials. Critical Materials are increasingly becoming a critical strategic resource since the global demand for several electronic devices, instruments,

defense equipment, magnets, and pollution control catalysts has been continuously rising every year. Also the Critical Materials can be found in most high-technology, from advanced military technology to mobile phone. Critical Materials are often called "a vitamin for industries" as the quality and performance of cutting-edge products largely depend on them. In these days, critical materials become a hot issue due to its core role to the main element as well as its rarity. Since the rarity is determined not only by its amount existent in earth, but also the balance between the demand and supply, the assurance has been propelled in various manners, such as exploration of new ores, recycling, substitution, etc. The symposium will commence with overviews of those minerals considered critical and updates on national Critical Materials strategies. This symposium will bring experts together from the different fields of state-of-art technologies of critical materials, which will foster the scientific exchange. Topics will include rare earths and critical materials for energy saving technology:

- **Critical Material Strategies**
- **Rare Earth Projects, Process Technologies, and Markets**
- **Recycling**
- **Environmental Issues**
- **Separation of REEs** - technology, chemical and physical feed specifications
- **Optical**, photonic, electronic, magnetic and energy applications

Symposium Organizers:

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(Symposium 9) Energy-efficient Printing and Additive Manufacturing Processes

The Printed Electronics market is getting bigger every year because of huge demand for renovation and cost reduction in industrial manufacturing process. In order to meet this soaring global demand, many research activities are being carried out and new development of printing methods are introduced. Recently, not only printing techniques such as gravure, offset, reverse, inkjet, nozzle jet, screen printing, but also Additive Manufacturing technologies are emerging for energy efficient industrial manufacturing process. In these various processes, many scientific and technical issues have to be resolved for smart applications for high-efficient and cost-effective manufacturing of electronic components. This symposium will bring experts together from the different fields of state-of-art technologies of Printed Electronics and Additive Manufacturing, which will foster the scientific exchange. This symposium will welcome contributed papers related to the following topics (but not limited to):

Materials for Printing and Additive Manufacturing Technology:

- Materials for Energy Harvesting Devices
- Materials for Display Applications
- Inorganic and hybrid Materials for Printed Electronics applications
- Structured materials for Printed Electronics applications
- Substrate for Printing Technology

Printing and Additive Manufacturing Process and Devices:

- Device Fabrication Processes for Printed Electronics applications
- Various Applications for Printed Electronics
- Characterization and Evaluation methods for Printed Electronics applications
- Equipment for Printing and Evaluation

Symposium Organizers:

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(Symposium 10) Young Scientists Forum on Future Energy Materials and Devices

The energy materials and devices research area addresses one of the most pressing challenges of our time: securing a stable base for energy supply. These challenges can be met by materials development approaches from various angles: no single approach is likely to suffice and an effective solution will require creative integration of several approaches including photovoltaics, photocatalysis, and hydrogen, as well as energy storage. Young scientists across the world are at the forefront of these activities and have potential to be leaders in their fields in the future. This symposium highlights significant contributions from early-career scholars and scientists on the problem of energy materials and devices. Contributed papers and presentations on the following topics will be primarily considered:

Materials for next generation energy harvesting and utilization:

- High efficiency energy harvesting devices
- High efficiency optoelectronic devices

Materials for next generation energy storage

- Secondary ion batteries and supercapacitors
- Hydrogen and other chemicals storage systems

Symposium Organizers:

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