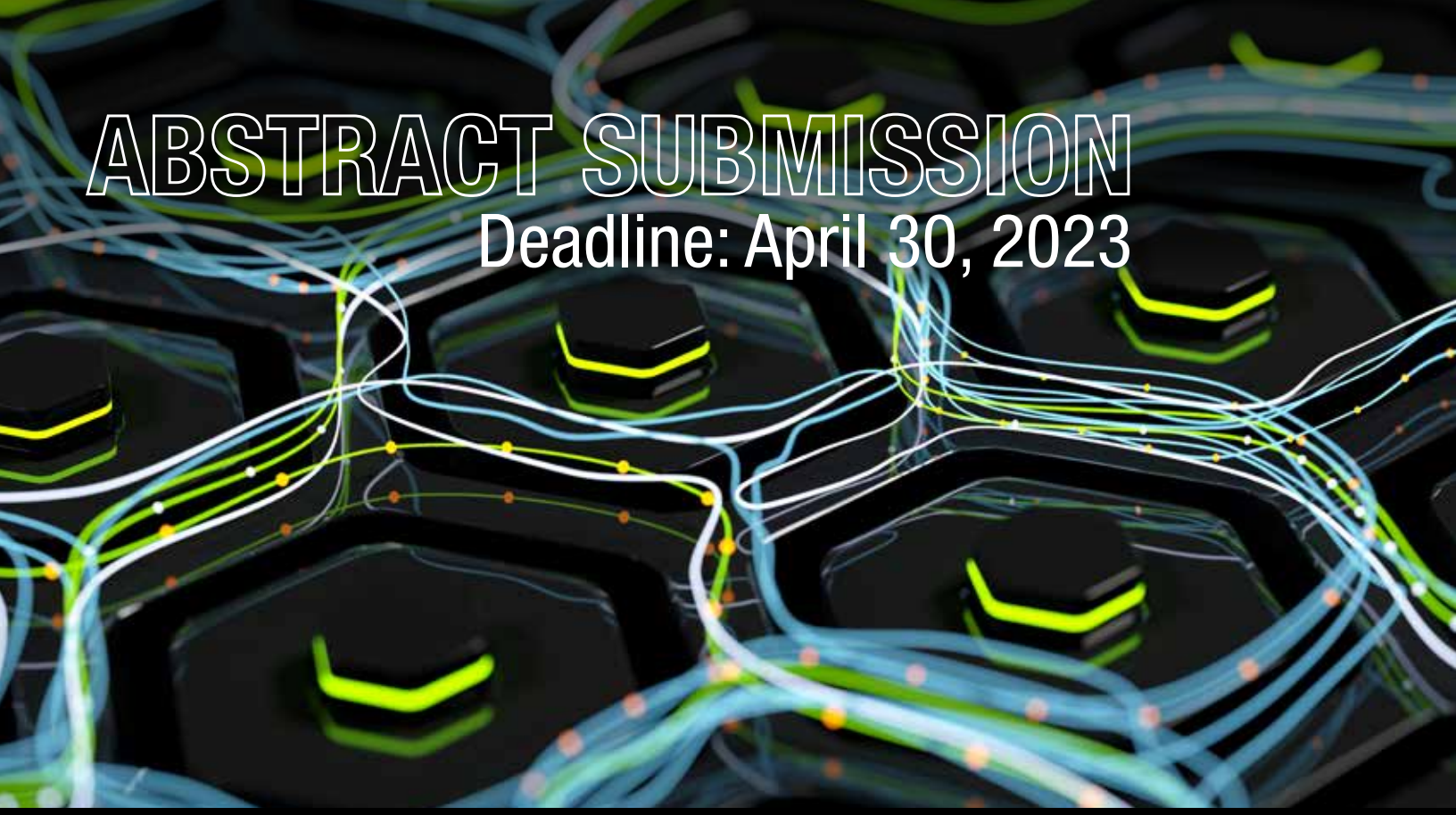

ABSTRACT SUBMISSION

Deadline: April 30, 2023

AUG. 21–24, 2023 | HYATT REGENCY BELLEVUE | BELLEVUE, WA, USA

MATERIAL CHALLENGES IN ALTERNATIVE AND RENEWABLE ENERGY 2023 (MCARE2023)

Combined with Energy Harvesting Society meeting (EHS 2023)

A joint meeting effort organized by ACerS Energy Materials and Systems Division and the Korean Institute of Chemical Engineers (KIChE)

Hosted and organized by:

The American Ceramic Society
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ENERGY HARVESTING SOCIETY

Also organized by:

KIChE
The Korean Institute of Chemical Engineers

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INTRODUCTION: MCARE 2023/EHS 2023

The Energy Materials and Systems Division of The American Ceramic Society and the Korean Institute of Chemical Engineers are working together to host the joint Materials Challenges in Alternative and Renewable Energy (MCARE 2023) combined with the annual Energy Harvesting Society meeting (EHS 2023).

MCARE has provided a premier forum to address opportunities of emerging material technologies that support sustainability of a global society. The EHS meeting is also highly successful in bringing the academic community from around the world together to openly discuss and to exchange ideas about energy harvesting. Combining these two meetings brings together leading global experts from universities, industry, research and development laboratories, and government agencies to collaboratively interact and communicate material technologies that address development of affordable, sustainable, environmentally friendly, and renewable energy harvesting and conversion technologies.

This cutting-edge international conference features plenary and invited talks, technical sessions, poster presentations, and a student professional development workshop, enabling participants to network and exchange ideas with professional peers and acclaimed experts. The conference atmosphere engages and promotes the participation of scientists and engineers in all stages of their careers, from early-stage researchers to seasoned professionals.

Abstracts are solicited from interested and committed individuals from academia, national laboratories, industries, and start-up companies in the technology symposia listed in this Call for Papers.

Join us to share your research in these areas and to freely discuss and network with colleagues from around the globe interested in sustainable energy solutions.

ABSTRACT SUBMISSION INSTRUCTIONS

Visit **www.ceramics.org/mcare23** to submit your 200-word abstract. Select "Submit Abstract" to be directed to the Abstract Central website. Please contact Karen McCurdy at **kmccurdy@ceramics.org** or **614-794-5866** with questions.

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AUG 21 – 24, 2023 | HYATT REGENCY BELLEVUE | BELLEVUE, WASHINGTON, USA

TECHNICAL PROGRAM

SYMPOSIUM 1:

Materials for Green Ammonia Cycling

Green ammonia production has received a lot of attention in recent years as an alternative to the traditional Haber-Bosch process to reduce CO_2 emission and energy consumption. The extraction of hydrogen from ammonia is also an attractive process using NH_3 as the H_2 storage medium. This symposium aims to develop key materials and processes for green ammonia production and conversion, which make up the green ammonia cycling. The green ammonia production process involves the electrochemical reduction of nitrogen and nitrates. It will also cover the photocatalytic and photoelectrochemical reduction of nitrogen/nitrates for ammonia synthesis. Green hydrogen production through ammonia conversion is also included in this symposium. Additionally, experts in the green ammonia production/conversion will gather and promote scientific exchange in related research fields.

Session topics

- Electrocatalytic/photocatalytic ammonia production
- Electrocatalytic conversion of ammonia for hydrogen production
- Green hydrogen production
- Theoretical modeling for green ammonia cycling
- Analysis of green ammonia cycling process

Organizers

- **Kijung Yong**, POSTECH, Korea, kyong@postech.ac.kr
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- **Jongwon Kang**, Lotte Chemical Corporation, Korea, jkang@lotte.net

SYMPOSIUM 2:

Advanced Materials for Energy Storage

Batteries are devices that convert chemical energy into electrical energy. There are many types of batteries available, representing a multibillion-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. New concepts in materials design for battery technology are sought to overcome the current limitations of performance and lifetime. More critical insight is required into both material structures as well as interfacial reactions to produce next-generation electrode materials and battery cells enabling higher energy densities, high power densities, and longer cycling abilities. This symposium explores novel energy storage materials and technologies that are critical to making the current energy storage systems more effective. In addition, abstracts are sought on supercapacitors and flexible batteries for self-powering small electronics. Abstracts are sought in fundamentals, modeling, mechanisms, materials design, screening, electrode architectures, diagnostics and materials characterization, and electrode/electrolyte interface characterization of the below session topics.

Session topics

- Lithium batteries
- Sodium batteries
- Magnesium batteries
- Lithium-air batteries
- Lithium-sulfur batteries
- Redox flow batteries
- All-solid-state batteries
- High-temperature batteries
- Flexible batteries
- Supercapacitors

Organizers

- **Ho Seok Park**, Sungkyunkwan University (SKKU), Korea, phs0727@skku.edu
- **Yan Yao,** University of Houston, USA, yyao4@uh.edu
- **Seung-Ho Yu**, Korea University, Korea, seunghoyu@korea.ac.kr
- **Jungjin Park,** Korea Institute of Science & Technology (KIST), Korea, jpark716@kist.re.kr

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SYMPOSIUM 3:
Advanced Materials for Fuel Cells and Electrolysis

Fuel cell technologies have attracted attention as a highly efficient power generation method. Among various types of fuel cells, solid oxide fuel cells have particularly high efficiency and flexibility in fuel. However, fundamental and applied research is essential to increase their performance and durability. Because similar materials are used, high-temperature electrolysis cells have also attracted attention for efficient electrolysis cells, particularly hydrogen production. This symposium will bring together leading researchers and technologists working in critical areas such as new materials, degradation processes, and systems engineering to discuss state-of-the-art developments in solid oxide fuel cells and high-temperature electrolysis.

Session topics

- Oxide proton conducting oxide fuel cells
- Electrolysis cells

Organizers

– **Jinwoo Lee**, KAIST, Korea, jwlee1@kaist.ac.kr

– **Sanghyun Ahn**, Chung-Ang Univ, shahn@cau.ac.kr

– **Prof. Dong Young Chung**, KAIST, dychung@kaist.ac.kr

SYMPOSIUM 4:
Spectral Conversion Materials for Energy Applications

Spectral conversion luminescent materials are potential candidates to increase the efficiency of solar cells as well as other environmentally relevant technologies, such as photocatalysis, solar fuels and artificial photosynthesis, where usually large parts of the solar spectrum do not contribute to the harvesting scheme and are lost for energy conversion. Downconversion or quantum cutting, luminescent downshifting, and upconversion are approaches to diminish these losses. Yet, while cutting edge research conducted around the globe led to promising achievements, remaining challenges (such as low quantum efficiency in nanomaterials, weak and/or narrow absorption, and broadband illumination under real sun conditions) have to be addressed in order to take full advantage of spectral conversion materials. In this context, the rational design of suitable optical materials is crucial for energy conversion enhancement, and approaches reach from novel host materials and dopant optimization for upconversion and downconversion materials to innovative hybrid materials, e.g. combing lanthanide-doped materials, quantum dots, organic dyes, carbon-based structures and photonic concepts.
It is the scope of this symposium to provide an interdisciplinary platform for the presentation and discussion of recent achievements, developments and remaining challenges regarding the design, synthesis and characterization of spectral conversion materials as well as their assembly to more efficient devices. Session topics will focus on, but not be limited to:

Session topics

- Materials for upconversion, downconversion / quantum cutting, luminescent downshifting
- Lanthanides, dyes and quantum confined nanomaterials for photovoltaic applications
- Spectral conversion for photo-catalytic and water-splitting applications
- Triplet-triplet annihilation photon-upconversion
- Development and synthesis of novel optical materials
- Smart assemblies and novel device design: Combining lanthanide-doped nanoparticles, QDs, carbon-based nanostructures, dyes etc. to enhance spectral conversion efficiency.
- Plasmonic / photonic manipulation of conversion processes
- Theoretical approaches and modeling
- Application-oriented approaches in spectral conversion
- Multifunctional spectral conversion materials: Applications beyond the energy sector

Organizers

– **Do Heui Kim**, Seoul National University, Korea, dohkim@snu.ac.kr

– **Eva Hemmer**, University of Ottawa, Canada, ehemmer@uottawa.ca

– **Yuanbing Mao**, Illinois Institute of Technology, ymao17@iit.edu

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TECHNICAL PROGRAM

SYMPOSIUM 5:

Materials for Hydrogen Fuel Production and CO_2 Conversion or Carbon Neutrality

With concerns about energy crisis and global warming, looking for renewable energy sources that are not harmful to the environment is one of the most critical tasks for us. For example, solar-to-fuel conversion is an appealing strategy to produce environmentally friendly fuels and attain sustainable energy systems. This symposium aims to share recent progress in the research area regarding the strategies to create renewable energy sources via reduction of CO2 emission. The topic of this session covers various research fields based on carbon-neutrality, providing an opportunity to actively discuss recent research trends and seek opportunities for collaboration. Through the presentations and discussions on the carbon neutrality, it will provide an opportunity to explore the future directions of this research area.

Session topics

- Photoelectrochemical cells and photo(electro) catalysts
- Solar driven production of fuels
- CO_2 conversion
- Hydrogen production and storage
- NH_3, H_2O_2 production

Organizer

– **Ji-Hyun Jang,** UNIST, Korea, clau@unist.ac.kr

– **Shannon Boettcher**, University of Oregon, swb@uoregon.edu

SYMPOSIUM 6:

Third Generation Photovoltaic Technologies with Emphasis on Perovskite Solar Cells and Modules

Low-cost and high-efficiency third-generation photovoltaic technologies, including dye sensitized solar cells, perovskite solar cells, and organic solar cells, could have a great impact on the global deployment of renewable energy harvest in the near future. Over the past two decades, halide perovskites were identified as one of the most promising photovoltaic materials, though this technology faces transition barriers of stability, toxicity, and performance hysteresis issues. Further advancement in both materials science and technical devising and manufacturing holds the potential to solve these practical problems. These scientific embodiments can be the design and development of novel functional materials, discovery of new mechanisms, invention of advanced processing and manufacturing, furthering applications of nanotechnology, intelligent material mining, interfacial/defect reengineering, and many other strategies yet to know. The overall goal of this symposium is to discuss promising solutions to the existing challenges in perovskite photovoltaics, strategize the roadmap toward standard commercialization, and jointly create additional opportunities for future development.

Session topics

- Fundamental physics of energy conversion in photovoltaics
- Advanced synthesis, manufacturing, and characterization techniques
- Materials and devices toward ultrahigh power conversion efficiency and operational lifetime
- Mitigation of solvent toxicity, lead toxicity, and recycling

Organizer

– **Kai Wang**, Pennsylvania State University, USA, kqw5449@psu.edu

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SYMPOSIUM 7:

Thermoelectric Energy Harvesting

Thermoelectric modules are solid-state devices that can directly convert heat to electricity and vice versa. This symposium will broadly cover a diverse range of topics, including all types of thermoelectric materials, generators and coolers, and their applications. Rapid progress has been recently made in discovery, fundamental understanding, and applications of thermoelectric materials and devices. In thermoelectric materials, not only do the high peak and average ZT of materials deserve attention, the mechanical properties, thermal stability, and oxidation resistance should be taken into consideration as well. Moreover, the thermoelectric society requires more efforts on thermoelectric module/device design, joint and brazing materials, and fabrication processes because the overall device performance, rather than the material performance, is the key factor that motivates the investment and research input and leads to the real application for energy harvesting and cooling. For small footprint devices, exploring micro- and nanotechnology approaches allows us to address together micromodule fabrication and low-dimensional materials integration. The overall intent of this symposium is to provide an opportunity for thermoelectric scientists and researchers to discuss critical issues and exchange their opinions in thermoelectric materials and device development, commercial application, and thermoelectric future.

Session topics

- Fundamentals of thermoelectric: Theoretical design of materials and device modeling
- Thermoelectric materials: synthesis and characterization of thermoelectric materials (bulk, thin film, heterostructures, and nanocomposites)
- Thermoelectric devices: Device fabrication, novel design for thermoelectric modules, thermal, and mechanical stability
- Applications: New ideas in thermoelectric applications, waste-heat recovery and cooling

Organizers

– **Bed Poudel**, Pennsylvania State University, USA, bup346@psu.edu

– **Armin Feldhoff**, Leibniz Universität Hannover, Germany, armin.feldhoff@pci.uni-hannover.de

SYMPOSIUM 8:

Piezoelectric and Triboelectric Energy Harvesting using Low-Dimensional Materials

Low-dimensional materials including nanowires, nanotubes, fibers, and nanomaterials have received growing interest in various research fields, including piezoelectric and triboelectric energy harvesting. Low-dimensional materials exhibit a wide range of unique mechanical, electrical, and electromechanical properties that are hardly observable at macroscales, offering substantial capability for applications in energy harvesting. For example, two-dimensional materials with a noncenterosymmetric structure have been experimentally confirmed or theoretically predicted as piezoelectric or triboelectric. This symposium will provide a great opportunity to actively share and discuss recent research knowledge and innovating ideas on low-dimensional materials, devices, and related technology for energy harvesting.

Session topics

- Fundamental physics of energy conversion and harvesting at the nano- and microscale
- Synthesis, fabrication, and characterization techniques of low-dimensional materials and devices
- Two-dimensional materials and devices for piezoelectric and triboelectric energy harvesting
- Nanomaterials and nanostructures for piezoelectric and triboelectric energy harvesting: nanowires, nanotubes, nanofibers, and composite nanomaterials

Organizers

– **Sohini Kar-Narayan**, University of Cambridge, U.K., sk568@cam.ac.uk

– **Miso Kim**, Sungkyunkwan University (SKKU), Korea, smilekim@skku.edu

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TECHNICAL PROGRAM

SYMPOSIUM 9:

Hybrid Energy Harvesting Materials and Devices

Mechanical vibrations, low amplitude magnetic fields, and low-grade thermal energy are freely available in our surroundings on variety of platforms. Conversion of this wasted energy into electricity with high efficiency can provide ubiquitous energy sources. To overcome the energy-insufficiency issue of a single energy harvesting device, hybrid energy harvesting systems have been proposed in recent years. Hybrid energy harvesting technology is not only using the energy from multiple sources, but also converting energy into electricity by multiple types of energy transduction mechanisms, such as piezoelectric, electromagnetic induction, triboelectrification, magnetoelectric coupling, pyroelectric, and thermoelectric, in single device structure. This symposium will review the fundamental physics, fabrication processes, modeling methods, and device design for hybrid energy harvesting materials and devices.

Session topics

- Fundamental physics and fabrication processes of piezoelectric, pyroelectric, thermoelectric, magnetoelectric, and electromagnetic materials for energy harvesting
- Low frequency vibration energy harvesting structures including piezoelectric, electromagnetic, and triboelectric
- Low grade thermal energy harvesting by pyroelectric and thermoelectric materials
- Modeling and device design for hybrid energy harvesting by multiple types of energy transduction mechanisms.
- Device implementation of hybrid energy harvesting technology

Organizers

– **Jungho Ryu**, Yeungnam University, Korea, jhryu@ynu.ac.kr

– **Mari-Ann Einarsrud**, NTNU Norwegian University of Science and Technology, Norway, mari-ann.einarsrud@ntnu.no

SYMPOSIUM 10:

Multi-functional Energy Conversion Materials and Devices for Energy Harvesting and/or Sensing

The increased demands for applications related to energy harvesting and sensing has led to the development of multifunctional materials that are capable of one providing more than one primary function, including the intelligent combination of structural, optical, electrical, magnetic, chemical, and thermal properties. Multifunctional materials can also combine a range of transduction mechanism to provide more efficient energy harvesting and/or sense a range of stimuli, including the combination of piezoelectric, electromagnetic, and triboelectric effects within a single device. The creation of such smart systems requires an understanding of fundamental mechanism, material development & design, materials manufacture, modeling tools, and ultimately the application and testing of such materials in existing and new applications.

Session topics

- Fundamentals of multifunctional materials and devices
- Design and manufacture of multifunctional materials
- Modeling of multifunctional materials and systems
- Multifunctional energy harvesting and sensing
- Application of multifunctional materials and devices
- Multifunctionality to provide radically new properties, including catalytic activity and water treatment

Organizer

– **Chris Bowen**, University of Bath, UK, c.r.bowen@bath.ac.uk

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SYMPOSIUM 11:

Materials and Process Challenges for Sustainable Nuclear Energy

Nuclear energy has the potential to become a sustainable innovative energy source when novel solutions can overcome accident potential and waste issues for the current fleet power plants. This symposium will focus on improved and advanced materials for alternative next-generation reactor concepts, for structure components, and fuels that enable innovative nuclear power. Challenges associated with nuclear waste management associated with the backend of the fuel cycle will also be addressed. With the advent of new reactor concepts, there is significant challenge to develop advanced materials to meet stringent requirements, i.e., high-temperature and corrosive environments. Thus, a systematic approach of modeling, processing, characterization, and in-service performance testing is required to bring new materials in use.

Session topics

- Modeling and simulation of radiation effects on structural materials
- High-temperature metals and alloys
- Advanced ceramics and composites
- Material performance in radiation environments
- Degradation mechanisms and lifetime predictions of material components
- Material behavior in accident environments
- Characterization of materials and nondestructive evaluations
- Heat transfer materials and coolants
- Materials and processes for radioactive waste containment and disposal
- Design, synthesis, and testing of waste forms
- Advanced fuels design and concept

Organizers

– **Yutai Katoh**, Oak Ridge National Laboratory, USA, katohy@ornl.gov
– **Krista Carlson**, University of Nevada, Reno, USA, kc@unr.edu
– **Charmayne Lonergan**, Pacific Northwest National Laboratory, USA, charmayne.lonergan@pnnl.gov

Scientific Communication Student Workshop

Organizer

– **Riccardo Marin**, Universidad Autónoma de Madrid, Spain Riccardo.marin@uam.es

Scientific results are valuable only when shared. Being able to share them in an effective way is an art to be mastered. At the heart of effective scientific communication is empathy with the audience, fundamental design skills, and the awareness of the way we access information in the fast-paced digital era of electronic journals and mobile apps.

In this workshop, you will be introduced to these concepts with a dynamic combination of interactive talks and hands-on sessions. Expert designers, scientific communicators, and seasoned researchers will bring you up to speed with the general principles to apply in the preparation of manuscripts, graphics, and presentations. Practical pointers will be discussed, which you will be able to put into practice during specially tailored exercises.

This workshop is for you if you want to take your science communication capabilities to the next level and complement your technical expertise with a cohort of soft skills that will bring you one step closer to becoming a professional scientist!