3:50 PM

(ICACC-GYIF-019-2025) Flexible Chemical and Fuel Production using Protonic Ceramic Electrochemical Cells (PCEC) for Energy and Materials-Efficient Manufacturing Processes (Invited)

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Protonic ceramic electrochemical cells (PCECs) are solid-state electrochemical devices using the proton-conducting oxide as the electrolyte. Besides power generation as fuel cells, PCECs is an emerging technology that could be employed for flexible chemical manufacturing by using a range of feedstocks. Economically competitive PCEC systems have distinct advantages over their counterparts at lower or higher temperatures, but further technology development and widespread market acceptance will require continuous innovation of materials and structures in order to improve cell performance, enhance system lifetime and reduce cost. Herein, we report the advancement of PCEC with new electrode component, catalyst integration, unique electrode structures as well as deep investigation on the state-of-the-art electrolyte materials to enable high-performance and robust operation for chemical and fuel production when sustainable feedstocks (e.g. steam, carbon dioxide and nitrogen) are used. Special emphasis is placed on intermediate temperatures, which shows potentials of PCEC as process intensified manufacturing processes technologies compared with those industrial mature processes. At the end, we will also highlight INL's effort on advanced manufacturing processes to scale up the technologies.

4:20 PM

(ICACC-GYIF-020-2025) Hexagonal boron nitride incorporated electrospun polyvinylidene separators with enhanced thermal conductivity and stability for safer Li-ion batteries (Invited)

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Because conventional lithium-ion batteries (LIBs) have limitations at high temperatures, their safety still remains a serious issue, which restrict the large-scale energy storage applications in different sectors including electric vehicles. The separator plays a critical role in ensuring the safe and efficient operation of LIBs and the present study focuses on the fabrication of hexagonal boron nitride (h-BN) incorporated polyvinylidene fluoride (PVDF) separator by the electrospinning technique. h-BN has excellent thermal conductivity and mechanical stability, and when incorporated into the highly porous electrospun PVDF matrix, promotes efficient heat dissipation in the separator during cell cycling. Additionally, this distinct fusion also improves the separator's wettability, ionic conductivity, and mechanical stability, which lead to better electrochemical performance. This presentation demonstrates h-BN-PVDF as a promising separator material with enhanced thermal stability that avoids thermal shrinkage, which ultimately prevents battery short circuit, allowing for safer LIBs.

4:50 PM

(ICACC-GYIF-021-2025) Sustainable Lunar Construction Using Freeze Casting and Sintering of Regolith (Invited)

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Space agencies are undertaking missions that aim to establish a permanent human base on the Moon within next two decades. Transporting resources from Earth to support that effort is prohibitively expensive, so the success of these plans will on-demand manufacturing of infrastructure, tools, and replacement parts using indigenous materials and energy sources. We explore the use of lunar regolith as the primary raw material in the sustainable fabrication of construction materials by freeze casting and sintering. We show that high-fidelity synthetic regolith can be transformed into lightweight or dense load-bearing components with intricate shapes through freeze casting, using a small volume of non-recyclable additives. Freeze casting has great potential to utilize the cold vacuum environment of the lunar polar regions for the freezing and sublimation steps, which may reduce the energy consumption required for shape fabrication. The key parameters, including the regolith composition, particle size distribution, and sintering conditions, play crucial roles in developing the physical and mechanical properties of the final material. This study paves the way for future research into scalable manufacturing methods that could support a long-term human presence on the Moon, reduce reliance on Earth-supplied materials, and enhance the sustainability and feasibility of in-situ resource utilization.

FS6 Innovative material processing for diverse resource circulation loops

FS6- Innovative material processing for diverse resource circulation loops II

Room: Ballroom 5
Session Chairs: Enrico Bernardo, University of Padova; Katsuya Teshima, Shinshu University

1:30 PM

(ICACC-FS6016-2025) Optimizing Concrete Performance with Recycled Crushed Glass Aggregate (Invited)

D. Alterman*[1]; C. Tokoro[2]; C. Gerber[1]; A. Narita[3]; T. Koita[2]; D. Jozwiak-Niedzwiedzka[4]

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4. Polska Akademia Nauk, Poland

This paper explores the feasibility of using recycled crushed glass as an aggregate replacement in concrete pavers and its effects on strength properties. The findings indicate that while recycled glass impacts strength, the effect is not detrimental. Results support the use of glass aggregate in construction, consistent with previous research. Though some mixes showed a slight reduction in compressive strength, flexural strength improved with more glass content. The slower rate of strength gain, potentially leading to long-term improvements, is an important factor for design consideration. Environmental conditions affected strength gain, though most mixes achieved design strength within 28 days. The slower pozzolanic reaction rate of glass can be managed through careful design and extended curing. No significant changes in slump or bleed water were noted, with a slight increase in air content, indicating mix designs can accommodate these variables. Durability concerns, particularly Alkali Silica Reaction were addressed by using fly ash and selecting appropriate aggregate size. Image analysis showed smooth, non-cubic glass aggregates, which enhanced flexural strength without affecting workability. In conclusion, recycled crushed glass is a viable aggregate replacement in concrete pavers, offering environmental and economic benefits when appropriate design measures are taken.

2:00 PM

(ICACC-FS6017-2025) Novel fabrication and disassembly processes for ceramic devices by chemical reactions near room temperature for material recycling (Invited)

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Most of ceramic devices are fabricated by co-sintering process at 1000 °C, recently, these processes are expected to change into cleaner process which can reduce the CO_2 emission in the device fabrication. In addition, these ceramic devices were difficult to disassemble for

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ABSTRACT BOOK

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