

UCSD NANOENGINEERING/CHEMICAL ENGINEERING
Virtual **SEMINAR SERIES**
Wednesday, May 19, 2021
Seminar Presentation: 11:00am - 12:00pm PDT
Zoom Seminar

*“Recent Developments in Safe Lithium Ion Battery Design
for Human Space Flight”*



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Abstract: Spaceflight is inherently dangerous, but failure scenarios commonly accepted in modern life are often unacceptable in human spaceflight. Lithium ion (Li-Ion) batteries present one such risk in the form of single cell thermal runaway. In multi-cell batteries, single cell failure can readily propagate throughout the battery assembly consuming each cell one after the other over a period of minutes to hours, leaving the user with little recourse to halt or interrupt the fiery progression. Selected for advantages in energy, power, and volumetric density, rechargeability and cycle life performance, and widespread adoption in the commercial marketplace, the dramatic nature of a battery failure warrants attention, especially when used in close proximity to human occupants, such as inside an orbiting vehicle or when used to power the spacesuit. This presentation introduces the Li-Ion batteries used to power NASA's spacesuit, discusses thermal runaway initiation methods, and summarizes the sequential development of three propagation resistant li-ion battery designs that form the basis of a propagation resistant battery design. Current efforts aimed at achieving the mass and volumetric efficiency required of mass-constrained human spacecraft are introduced, and video examples of propagating and non-propagating designs are included.

Biosketch: **Samuel Russell** is a Project Manager and Systems Engineer at NASA Johnson Space Center responsible for the design, development, and sustaining of battery systems for human spaceflight. With more than twenty years of experience in propulsion and power systems, he managed the development of the first Li-Ion battery in critical human space application, helped advance propagation resistant battery design, and managed the development of the first three propagation resistant Li-Ion batteries in human spaceflight. In addition to leading multiple hardware development projects, he also serves as the Portfolio Manager for the NASA JSC Battery Group, which includes battery, charger, and power supply development, engineering, test, and systems management activities; battery safety requirement management; and, serving as the battery technical authority for each human spaceflight program. Sam holds a B.S. in Environmental Engineering and a M.S. in Materials Engineering from New Mexico Institute of Mining and Technology, is a Doctoral Candidate at Stevens Institute of Technology, and is a two-time recipient of the JSC Director's Commendation Award.

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