From Membranes to Mars: Development of Novel Ionic Liquid Composites Toward Advances in Separation and Materials Science for this World and the Next.

Ionic liquids (ILs) are molten salts that exist as a novel class of materials and have found several uses as reaction solvents, absorbers and within gas separation systems. Structural modifications have given rise to new classifications of ILs as polymeric mimics, ionogels, and binding agents. Further, recent studies suggest significant potential for their use in space technology due to their temperature stability and negligible vapor pressure. The first section of the talk will focus on the use of ILs in electrodialysis (ED) and electrodeionization (EDI), electrically-driven separation processes aimed at water treatment through ion removal. ED and EDI are efficient membrane separation processes for water treatment, yet selective ion separations have been limited due to the inability of ion exchange membranes to effectively limit the transport of specific ion species. This work demonstrates that modification of ion-exchange membranes with thin-film PIL coatings can exhibit enhanced ion selectivity with comparable separation efficiency to uncoated membranes. These results suggest that ion-selective ion exchange membranes would result in improved productivity for water treatment in various applications, such as industrial wastewater reuse, agriculture, and hydraulic fracturing. The second section of the talk will discuss opportunities for ionic liquid epoxies (ILEs) within space technology with emphasis on the role additive manufacturing plays in developing novel materials for space technology. One of the key areas of NASA mission-supportive research in the past few years is the development of *in situ* structural materials for Earth-independent explorations. This work investigates the potential of ILE-based composites to serve as binding agents and extraction solvents for *in situ* construction using simulated Lunar and Martian regolith. Results indicate that while ILE-based materials can be used for *in situ* construction, the degree of binding is highly dependent on regolith concentration and the environmental conditions during curing, resulting in significant changes to the thermomechanical properties of the final composites.

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Dr. Alexander Lopez currently serves as an Assistant Professor of Chemical Engineering at the University of Mississippi. He received his Bachelor's in Chemical Engineering at the University of Arkansas in 2011 and his Ph.D. in Chemical Engineering from the University of Arkansas in 2015. After completion of post-doctoral study at the University of Colorado Boulder, He joined UM's Department of Chemical Engineering in August 2016. Dr. Lopez's research is focused on the synthesis, characterization, and testing of polymer/ionic liquid based composite materials for use within thin films, coatings, and membranes for water production, wastewater treatment, energy production and storage, gas separation, and charged product separations. Current research efforts at UM also include the development of IL and IL/ILE composite materials for mineral extraction, improved mechanical properties of 3D support structures as well as the development of novel coatings for improved thermal and impact resistance. Dr. Lopez is committed to improving the impact that research and STEM educational activities and outreach can have in Mississippi as well as mentoring women and members of underrepresented minorities in their efforts to pursue careers in STEM fields in industry and academia.