Water Desalination and Purification

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Securing a reliable supply of water among growing human populations, changing climate, and increasing urbanization is a global challenge. Water-stressed regions are exploring alternative sources to augment their freshwater supplies. This session focuses on membrane separation processes to desalinate and purify a range of source waters. Innovations in materials, developments in new processes, and synthesis of novel systems are emphasized for applications spanning desalination, wastewater reclamation, and treatment of industrial streams with complex solution chemistries.

RO desalination is currently the most efficient and widely adopted commercial desalination technology; however, it still requires a great deal of energy to create the high pressures necessary to overcome the osmotic pressure of saline waters and there are often significant issues with disposal of brine resulting from the process. Technological advances are needed to improve the energy efficiency, contaminant removal, and environmental impacts of the processes. Current focus is on improving sustainability in conventional applications such as sea- and brackish-water desalination and also exploring emerging opportunities in municipal and industrial wastewater desalination markets.

To ensure high process performance, membranes with high flux, high rejection, and low tendency for fouling are most desired. These membranes would be used in emerging and conventional treatment processes that provide consistently high process performance, require few chemicals, and produce little waste. The goal is to develop highly efficient, reliable, and durable treatment systems that can be scaled for use in distributed or centralized applications. Centralized systems capitalize on use of existing infrastructure; smaller-scale, distributed systems may offer better opportunities for coupling treatment with alternative energy sources. Sustainable system performance is key for efficiency and economics as well as health and regulatory standards.

The session will provide the audience a forum to discuss and identify collaborative opportunities in four critical areas of water desalination and purification (new materials development; analytical characterization techniques; emerging desalination technologies; and innovative system design and operation). The session will begin with a talk by Manish Kumar (Pennsylvania State University) providing a high-level overview of current reverse osmosis technology, corresponding application spaces, and most recent membrane chemistry innovations. Chris Stafford (National Institute of Standards and Technology) will dive deeper into current state-of-the-art polyamide membrane chemistries and will emphasize the importance of advanced membrane characterization techniques to drive breakthrough innovations. Baoxia Mi (University of California, Berkeley) will introduce emerging desalination treatment technologies and highlight new materials being developed to further advance these technologies. Kevin Alexander (Hazen and Sawyer) will wrap up the session with a techno-economic assessment of high recovery treatment from impaired waters including applications with challenging solution chemistries or requiring zero liquid discharge.