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Polymeric membranes for clean water and clean energy

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Clean water, clean energy, global warming and affordable healthcare are four major concerns globally resulting from clean water shortages, high fluctuations of oil prices, climate changes and high costs of healthcare. Clean water and public health are also highly related, while energy is essential for sustainable prosperity.

Among many potential solutions, advances in membrane technology are one of the most direct, effective and feasible approaches to solve these sophisticated issues. Membrane technology is a fully integrated science and engineering which consists of materials science and engineering, chemistry and chemical engineering, separation and purification phenomena, environmental science and sustainability, statistical mechanics-based molecular simulation, process and product design.

In this presentation, we will introduce our efforts on novel membrane development for clean water production and osmotic power generation, then highlight our recent development on functional membranes for biofuel separation, natural and hydrogen purification and separation.

The osmotic power generation via the mixing of water streams with different salinities across a semi-permeable pressure retarded osmosis (PRO) membrane will be our focus. If the osmotic power generator is integrated with the reverse osmosis (RO) plant using its retentate as the draw solution, not only are we able to mitigate the disposal issues of RO retentate, but also lower the overall energy consumption for RO plants. As a result, seawater desalination will be much cost-effective and this integration will entirely revolutionize the future desalination industry and energy production.

Keywords: membrane technology, clean water, clean energy, osmotic energy, biofuel, gas separation