Membrane Materials and Processes

Ion exchange membrane separators in all-organic redox flow-batteries

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Introduction
The ever-growing global population makes the transition from a fossil fuels-based society to a society based on renewable clean energies the first priority. Solar and wind energies are so far the fastest-growing sources of electricity. However, there is a shift between the peak hours of electricity production and the peak hours of energy consumption, hence, a need of high capacity electricity-storage devices is essential. All-organic redox flow-batteries (RFBs) are promising candidates for grid electricity storage due to their high storage capacities.

Project summary
All-organic RFB is a relatively new technology; It uses a flow of redox active organic molecules dissolved in an organic solvent to produce electricity. The main advantage over aqueous RFBs is their stability in a broader range of potential; This extended potential range is challenging as most of the organic molecules or polymer are sensitive to potential gradients.

The ion exchange membrane (IEM) is subjected to harsh organic solvents and high electrochemical potential gradients. Those combined effects lead to IEM deterioration and fading of RFBs capacity due to the crossover of redox active species from one side of the RFB to the other. Most of the academic research on all-organic RFBs uses commercial IEMs designed for aqueous environments. There is a strong need for IEMs able to withstand all-organic RFBs working conditions.

Project goals
This challenging project is dedicated to the development of IEMs able to withstand the organic solvent environment and broad electrochemical potential gradients. This project is multidisciplinary going from the design of IEM materials (synthesis of IEM or modification of commercial polymers) to the characterization of their behavior as ionic conductors in harsh environment and RFB performance testing. This project can fit with several types of student’s background like organic chemistry, electrochemistry, materials science or chemical engineering.

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