A Halide/Organic Membrane-Free Redox Flow Battery

Beall, Otto (School: Plano East Senior High School)

As the world pivots away from fossil fuels, the challenge becomes to satisfy the world's energy needs with intermittent zero-carbon sources such as wind and solar energy. In order to balance supply and demand for electricity, grid-scale energy storage is required. Currently, the most efficient way of storing electrical energy is Lithium-ion batteries, yet this technology requires a significant input of expensive rare-earth metals, which limits their scalability for grid-scale applications. An emerging alternative is the Redox-flow battery, which relies on separated tanks of aqueous analyte and catholyte solutions which react in a central fuel cell. Current Redox-flow batteries rely on vanadium ions dissolved in water. However, the expense of Vanadium and the need for an expensive porous ion membrane limits the economics of this technology. The purpose of this project is to develop a redox flow battery based on inexpensive organic ions, without the need for an ion membrane to separate the cell's redox-active species. The intended composition of the cell requires the immiscible media of dichloromethane and water, with sodium bromide and sodium chloride dissolved in water and Anthraquinone dissolved in dichloromethane. The different redox pathways of anthraquinone in an aprotic solvents and the BrCl2 trihalide ion will cause a difference in cell potential voltage which allows such a cell to be used for electrochemical applications.