Lithium Extraction from Salt Lake Brines via MOFs-based membrane

Nearly all innovations in technology use lithium batteries for power. In light of this, the global demand for Lithium has rapidly increased, and it is predicted that by 2030, demand will exceed supply, creating a significant global shortage. In response, efforts have been made to extract lithium from salt-lake brines, which account for 60% (or more) of the world's total supply. However, magnesium also exists in these brines, and it is challenging to separate Mg^{2+} and Li^{+} ions due to their similar chemical properties. Capable methods have significant issues involved, such as environmental damage, corrosion, and a short service life of the membrane. My partner and I with electronics and computer-related projects. Recognizing that a lack of lithium may hinder innovation within our passion, we decided to tackle this issue and create a membrane with the objectives of being environmentally friendly, adjustable, and effective for Li/Mg separation from these brines. To do this, we utilized the ion sieving properties of the MOF specimen UIO-66 to facilely create a membrane through the hot-pressing method, firmly adhering UIO-66 particles to a polypropylene substrate. This membrane was then placed between an H-Cell setup, and a current was run through to drive ions through the membrane, enabling separation. Measuring the ion conductance of Mg^{2+} and Li^{+} ions, we discovered the ion selectivity to be very high, at 2182 (ratio of one Mg^{2+} to 2182 Li^{+}), and how it would rapidly drop as we increased the temperature since the Mg^{2+} ions gain enough energy to dehydrate and pass through the membrane. A Li^{+} permeation flux two magnitudes higher than that of Mg^{2+} ion was consistently observed; however, as time progressed to 3h, the flux of Li^{+} spiked unexpectedly. Using our ion selectivity and permeation flux, on an industrial scale, we calculated that our membrane would produce 1361 Kg of lithium with a 99.97 purity per year, creating a sustainable method able to fix the lithium shortage in our economy and drive digital innovation forward.

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