Numerical Simulation of Multi-barrier Microfluidic System for Lithium Extraction from Salt Lake Brines

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ABSTRACT

Ion concentration polarization (ICP)-based microfluidic device for efficient extraction of lithium from salt-lake brines is highly desirable in dealing with industrial and environmental concerns. Related studies of lithium extraction from brines are limited in reliance on filters, brines conditions, and their economic and scalability, making it technically challenging to extract lithium in high Mg^{2+}/Li^{+} ratio (MLR) brines. In this paper, an ICP-based system was proposed for ion extraction, enabling simultaneous Mg^{2+} removal and Li^{+} extraction from high MLR brines (usually higher than 6). Multi-barrier structure, assigned to regulate the distribution of fluid flow, together with the ICP phenomenon aroused from the electric field, could supply a competitive force environment for differently charged particles, realizing the separation and enrichment of multiple ions with different transport characteristics. The two-dimensional numerical simulation results showed that this system could recognize 4.33 times enrichment of Li^{+} while further greatly decrease the concentration of Mg^{2+} to 0.21 mM. This system can then provide theoretical guidance on economic lithium extraction from high MLR brines.