2D Nanocomposite Aerogels for Efficient Lithium Recovery from Aqueous Sources

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Abstract

With the increasing demand for lithium in industries such as electric vehicles and renewable energy, concerns have arisen regarding the depletion of global lithium reserves and the environmental impact of mining. This research focuses on the recovery of lithium from diverse water resources, including brine water, wastewater, and seawater, to address the need for sustainable lithium production. Our goal is to fabricate a high-performance adsorbent and incorporate it into effective lithium recovery technologies, thereby paving the way for a circular economy in the lithium-ion battery domain. One promising approach to be explored is the utilization of 2D material-based nanocomposite aerogels, leveraging modified cellulose—the most abundant polymer in the world—as the primary structural component. The use of these modified cellulose-based aerogels offers significant advantages, particularly in the ease of recovery and handling of the adsorbent material, which is more practical compared to dealing with nanomaterials separately. In this study, various modified cellulose-based aerogels were developed and tested as lithium ion-selective adsorbents, including those incorporating MXene, sulfonated graphene oxide, and ionic liquid. The performance of these aerogels in lithium-ion adsorption was evaluated successfully, providing insights into their potential application in lithium recovery technologies. The findings from this research could offer valuable pathways to reduce the environmental footprint of lithium extraction and enhance the cost-effectiveness of lithium recovery processes, contributing to the long-term sustainability of the lithium-ion battery industry.