

Synthesis and Properties of Advanced Lithium Ion Adsorbent

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Summary

The international market share of lithium being used in many fields has grown significantly over last few years. The interest in lithium sources has been increasing because of its wide applications to lithium-ion rechargeable batteries and other compounds. Lithium is found in lakes and brines, and exist in several minerals such as spodumene, petalite, lepidolite, and amblygonite. Seawater is also considered as a vast source of lithium, although the concentration of lithium is 0.17 mg/L. Spinel-type manganese oxide (LiMn_2O_4) is a suitable material for its remarkably high selectivity for lithium ions in the aqueous phase, but it has a low chemical stability against lithium insertion-extraction reaction. The purpose of this study is to improve the chemical stability of LiMn_2O_4 for the recovery of lithium from brine and/or seawater. A series of metal-oxide-coated lithium ion adsorbents was synthesized, adding different metal-hydroxide precursors (Al, Mg and Ni) on spinel LiMn_2O_4 followed by oxidation at 600°C. It was recognized by X-ray diffraction that spinel-type structure was maintained after heating. Transmission electron microscopy revealed that their surface was partially covered with metal-oxide layers with a thickness range of 10-15 nm. Loaded metal-oxide contents were 2.09 wt% of Al, 1.81 wt% of Mg and 4.05 wt% of Ni, respectively. The influence of metallic species on chemical stability of resulting materials using 0.25 mol/L HCl for 90 min was investigated by inductively coupled plasma spectroscopy. As a result, alumina-coated LiMn_2O_4 showed lower manganese dissolution (42% decrease) and similar lithium extraction, compared with that of the raw LiMn_2O_4 . It was caused by Al^{3+} being well substituted to Mn^{3+} in the spinel lattice. Works on finding eluents with higher lithium uptake and less manganese dissolution under multi-cycle operation is now in progress.