

Physico-Chemical nanomaterials science

Structural characteristics and sorption properties of lithium-selective composite materials based on TiO_2 and MnO_2

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Interest to the sources of lithium raw materials is increasing due to widespread use of this metal in lithium power sources and other areas. The deposits of lithium mineral resources do not satisfy the growing market demand. In this regard, technologies of lithium ions recovery from aqueous media - sea water, geothermal waters, and brines – are in demand [1].

Modification of existing sorbents in order to obtain selectivity to lithium ions may be performed by directional template thermal synthesis. As a result of heat treatment, the materials obtain ion sieve properties due to directional structuring caused by condensation processes. The composite ion-exchange material based on TiO_2 - MnO_2 was synthesized by the proposed method. These materials are integral material with size of aggregates about 30-200 nm according to electronic microscopy data.

Obtained ion exchangers exhibit high selectivity for the absorption of lithium ions from the solutions with high salt background. Increasing of the treatment temperature in the range of up to 700 °C leads to contraction of the material structure and reduces the kinetic characteristics; however the formation of more lithium-selective sorption centers occurs, which positively affects the sorption capacity and lithium ion distribution in the system of ion exchanger-solution. This synthesis method allows us to obtain mesoporous materials with high distribution coefficients of lithium (up to $K_d = 162$) and the diffusion coefficient common to inorganic sorption materials (10^{-12} - 10^{-14} m^2/s). Sorbents with best combination of selectivity and rate of sorption have been used/applied for direct electrodeionization of solution that contained Li and Na ion ($C_{\text{Na}}/C_{\text{Li}} = 25$). Mainly Li ion removed to diluate.

Nishihama S., Onishi K., Yoshizuka K. Selective recovery process of lithium from seawater using integrated ion exchange methods // Solvent Extraction and Ion Exchange. - 2011. - 29. - P 421-431.