Cathode Material Based on Ultradispersed Lithium Ferrite Obtained by Ion-Exchange Mechanism

Regush L.

Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, Ukraine

Lithium pentaferrite $LiFe_5O_8$ is a promising cathode material for lithium power sources due to its structural and thermodynamic properties. Material nanostructured state is an additional factor that contributes to its electrochemical characteristics. Lithium pentaferrite was obtained by ion-exchange reactions in the ethanol. Several series of $LiFe_5O_8$ samples with different duration of the reaction were synthesized. It was found that with increasing duration of synthesis causes a decrease of the specific surface area of the obtained material (Fig.1,a). Changes of the material morphological characteristics affect its electrical properties and determine the effectiveness of its use as part of the electrode composition. As studies have shown (impedance spectroscopy method), the maximum conductivity is recorded for a sample obtained by synthesis duration of 1.5 days (Fig. 2, b). Non-monotonous conductivity $\sigma_{dc}(\omega)$ depending on the synthesis conditions is explained by the influence of two competing factors on the material conductivity. Reducing the particle size leads to an increase in the relative content of interparticle boundaries, but at the same time increasing the number of points of ohmic contact between the particles. Growth of sizes leads to lower reactance component, but deteriorating conditions of the transition between the current carrier particles. Thus superposition of these factors gives to each of the samples certain value of conductivity. These materials were tested as the basis for cathode composition for lithium power sources (LPS). Cathode mixture was consisted of $LiFe_5O_8$ (78 wt.%) with acytelene black (10 wt.%) and PVDF (12 wt.%). Metallic lithium was an anode. 1 M $LiBF_4$ in γ-butyrolactone was an electrolyte. Discharge curves for LPS with cathodes based material $LiFe_5O_8$ obtained by synthesis of various duration are presented in Fig. 3. The maximum capacity is achieved for the material synthesized during 1.5 days and it is 450 mAh/g. This result is consistent with the results of change in conductivity of $LiFe_5O_8$ samples. LPS based on this material was tested by potential-dynamic method. It was proved that the using of ultradispersed lithium pentaferrite is a promising for the design of LPS.

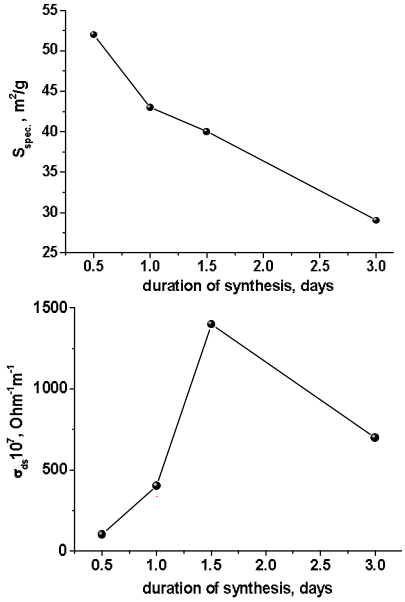

Fig.1.Specific surface area of obtained $LiFe_5O_8$ (a) and their specific electric conductivity (b) as functions of synthesis duration

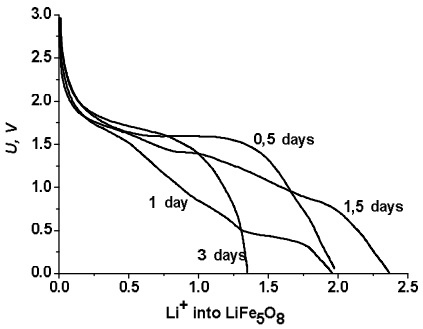

Fig.2. Discharge curves of the LPS with the cathode based on the samples of $LiFe_5O_8$ obtained at the different synthesis duration