

## **ELECTROCHEMICAL PROPERTIES OF THE SOLID LITHIUM-CONDUCTING ELECTROLYTE/ELECTRODE MATERIAL INTERFACE**

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The paper is related to the field of lithium secondary power sources.

Application of solid lithium-conducting electrolytes allows to use metal lithium as an anode material in lithium secondary batteries, as far as the hazard connected with a dendrite formation and short circuits at battery charging is eliminated.

Solution of such an applied task is based on the investigations of fundamental problems connected with the properties of super-ionic conductors - solid electrolytes. They are as follows:

- a) effect of the structure and a solid electrolyte composition on the mechanism and rate of a charge transfer in its volume,
- b) properties of the lithium-conducting electrolyte/intercalation electrode material interface,
- c) kinetics of electrochemical processes at the solid electrolyte / electrode material interface.

Inorganic materials based on the mixtures comprising metal oxides, including lithium oxides, were used as solid electrolytes. Amorphous glassy structure provided for its increased ionic conductivity.

Metal oxides ( $\text{MnO}_2$ ,  $\text{LiMn}_2\text{O}_4$ ,  $\text{V}_2\text{O}_5$ ) and sulfides ( $\text{FeS}_2$ ) were used as the electrode materials.

Thin layers of solid electrolytes were synthesized by using vacuum thermal and magnetron radio-frequency method. Electrolyte layer thickness ranged from unit to a few tens of micron. To characterize the materials the methods of XRD and SEM were used.

In terms of a solid electrolyte conductivity the problem concerning the relation between electron and ionic conductivity of the system is essential. Conductivity of solid electrolytes was investigated and measured by the method of electrode impedance and non-contact electromagnetic (eddy current and capacity) methods. Ionic conductivity of synthesized solid electrolytes reaches the value of the order of  $10^{-4}$  of magnitude.

The electrochemical properties of the solid electrolyte/electrode interface were investigated by using the following standard electrochemical methods: cyclic voltammetry, galvanostatic cycling, electrochemical impedance spectroscopy and transient technique (e.g. Chronoamperometry, CV) in which the applied potential is abruptly stepwise changed from one oxidation state to another. The CV potential step experiment was used to study the  $\text{Li}^+$  transport.

The comparison of such electrochemical process parameters as the rate constant of redox process and the diffusion coefficient of lithium cations in a solid phase of electrolyte were carried out for the systems based on liquid, polymer and solid electrolytes.

In a number of experiments the systems where by vacuum thermal and magnetron radio-frequency

method the thin layers of cathode material and solid electrolyte were successively applied. Application of solid electrolyte increases system cyclicality as compared with liquid nonaqueous electrolyte.

Actual samples of flat lithium secondary batteries have been manufactured and tested as a solid electrolyte of the synthesized materials.