AKTION

Report on results obtained by the project AKTION named " **Ionic liquids for intercalation reaction of lithium and sodium ions for advanced batteries",** No. 73p6 until the end of year 2015

Participants of the Project are:

a. Vienna University of Technology, Institute of Chemical Technologies and Analytics

Leader- prof. Günter Fafilek

b. BUT, FEEC, Department of Electric and Electronic Technology

Leader- Doc. Ing. Marie Sedlaříková, CSc.

The project consists of common investigation of new materials for hi-tech batteries based o anhydrous systems and alkali metals. It can be divided onto three parts:

- Research on negative electrode
- Research of positive electrode
- Research on ionic liquid (IL) as electrolytes for lithium ion batteries

Main research activities were in year 2015 concentrated on the replacement of lithium system in lithium secondary cells by an analogous system based on sodium.

A. Negative electrode

The most important point is the possibility of carbonaceous materials to work as negative electrode based in the principle of intercalation. The main idea of this section was to confront the ability of graphite used currently lithium secondary cells as material for negative electrode in the case of lithium to be substituted by sodium.

6 various natural graphite samples were examined together with "expanded" graphite prepared by the action of sulphuric acid followed by thermal treatment for removal of the sulphate ions. Fairly interesting results were obtained using graphite CR 5995 (Graphite Týn n. Vlt.) and the comparison with the lithium analogy could be done. In general, the intercalation of sodium seems to be several times slower than that of lithium. As for potential of intercalation, the maximum of reaction with comparison to sodium reversible potential is lower, but the essentially more negative potential of lithium intercalation must be taken in consideration. Both these effects can be ascribed to larger diameter of sodium ions in comparison to lithium ions, this influences the kinetics mainly and the reversibility can be understand easily.

Another field of interest is testing possibilities of application Silicon from Si wafers as material for high capacity anodes for sodium batteries. The samples were produced by cutting from Si wafers, which will be adequate for testing in the electrochemical test cells. This research is at the beginning and fundamental results are expected during the year 2016.

According to the results, the design of sodium batteries would be without serious problems.

B. Positive electrode
   This material is investigated by Tomáš Kazda and he is expected to deliver a manuscript at the end of 2016. It was synthesized cathode material containing Na, Ni and Mn. By several physical analysis was proved the correctness of the synthesis and also phase purity of the synthesized material. It was performed also basic electrochemical testing confirming the activity of the cathode material in combination with sodium metal.
C. The IL as the electrolytes will be studied also in the course of 2016.

The overall impact of the work is in the replacement of lithium in modern aprotic batteries by sodium. As a whole, the final cost of lithium batteries has reached the bottom and cannot be suppressed more due to the price of lithium compounds. Their replacement by sodium would be fairly prospective.