

OZONE MODIFIED GRAPHITE AS A MATERIAL OF THE NEGATIVE ELECTRODE FOR A LITHIUM-ION BATTERY

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Keywords: carbon electrodes, graphite, ozone,
lithium-ion batteries

Lithium intercalation in a carbon matrix during a charge and its deintercalation during a discharge of lithium-ion batteries take place. As a rule, on the first charge-discharge cycle the process is characterized by appreciable irreversibility. The reason of the irreversibility consists of reduction of an electrolyte components (solvents and salts' anions) at carbon surface. This phenomenon is especially pronounced at graphite electrodes in propylene carbonate (PC) based electrolytes. Meanwhile, PC has a number of advantages e.g in comparison with ethylene carbonate (EC). Indeed, m.p. of PC is sufficiently lower than that of EC, and solubility of the most of salts in PC is more than in EC.

One way to eliminate the specified lack of the combination "graphite-PC" is the use of proper pre-treatment of graphite, and particularly, its soft [1, 2] or severe [3] oxidation.

In the present work, the electrochemical behaviour of electrodes made of natural graphite modified by oxidation in O₃/O₂-mixtures with the subsequent treatment by a solution of butyl-lithium in cyclohexane was investigated. The electrodes were cycled in potentials range from 0.01 to 1.2 V (vs. Li/Li⁺-electrode) in two types of electrolytes – LP-20 (based on propylene carbonate) and LP-40 (based on ethylene carbonate). Both electrolytes were supplied by Merck.

IR study of initial and treated graphite revealed an appearance of large number of –COLi groups and disappearance of C=O groups at the surface.

The use of ozone-treated graphite for electrodes fabrication was shown to allow a drastic decrease in irreversible capacity of the electrodes at the first cycle and an increase in capacity stability during further cycling. The especially great effect of graphite modification was shown in the electrolyte LP-20. It was marked that the treatment of graphite in O₂-8% O₃ mixture renders stronger modifying action, than the treatment in O₂-5% O₃ mixture. However more rigid oxidation of graphite tends to the decrease in the electrode stability. The results of electrochemical tests (current density 16 mA/g) of electrodes, made from graphite with different prehistory, are shown in Figs. 1 and 2.

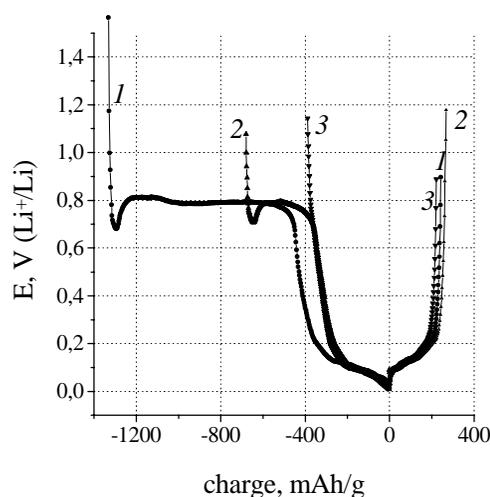


Fig. 1. Charge-discharge curves for the 1st cycle. LP-20, current density 16 mA/g. 1- untreated graphite, 2- treatment with 5% ozone in oxygen, 3 – treatment with 8% ozone in oxygen

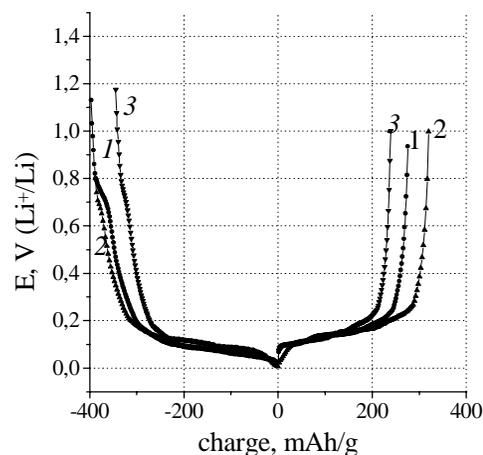


Fig. 2. Charge-discharge curves for the 1st cycle. LP-40, current density 16 mA/g. 1- untreated graphite, 2- treatment with 5% ozone in oxygen, 3 – treatment with 8% ozone in oxygen

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