MORPHOLOGY OF CADMIUM DEPOSITED FROM GEL ELECTROLYTES

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Introduction

The aim of this work was to simulate the charging process occurring in negative electrodes of lithium secondary batteries. The use of lithium is bound to the necessary use of strictly aprotic electrolytes which do not generate any hydrogen ions. We decided to simulate the process of metal electrodeposition using the electrodeposition of cadmium. Lithium is extremely unstable in air. Contrary to it, cadmium metal is much more stable, can be simply transferred from experimental cell to electron microscope and so forth. For this purpose, the electrodeposition of cadmium from liquid and polymer electrolytes was studied.

Electrolytes

The morphology of electrodeposited layers was studied by the use of electron scan microscope Phillips XL30 enabled with the analyzer EDAX. The microphotographs proved, that cadmium is formed in the form of dendrites with use liquid aprotic electrolytes. These dendrites loose contact with the substrate and they cannot participate in the charging – discharging process any more. Moreover, they create a danger of short circuits between negative and positive electrodes. This observation is very similar to the main problem of lithium secondary batteries which contain metallic lithium as the negative electrode. In our laboratory, we have developed an elektrolyte in which the propylene carbonate solution of a salt is immobilized by polymethyl methacrylate (PMMA) prepared by our original method. It consists in mixing of the propylene carbonate solution with the polymerization precursors of the PMMA resin called SUPERAKRYL (Spofa Dental, ltd.) After hardening at elevated temperature, an elastic, transparent and stable gel is formed. The microphotographs proved, that deposited cadmium consisted of grains homogenously distributed on electrode surface with use gel aprotic electrolytes.

Conclusions

An important phenomenon was observed during the deposition from gel. When proper voltage was applied, the current decreased rapidly from the initial value almost to zero. We have created a hypothesis, according to which the absence of natural convection is

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accompanied by a depletion of the gel on cadmium salt, thus causing a formation of an almost non-conducting layer in which the cadmium ions are transferred to the electrode by diffusion only. The quality and morphology of deposited layer is also influenced by that phenomenon.
These results are interesting for the application in lithium batteries. First, our simulation has confirmed the importance of the immobility of the electrolyte on the quality of electrodeposited layer. Second, the problem of electrolyte depletion resulting by the deposition or electrode charging has to be investigated more extensively.
We shall continue our research. First of all, we shall investigate the influence of electrode potential on the quality of electrodeposited layer and we shall test the possibility of electrodeposition of alloys, presumably Cd – Zn.

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References

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