GRAPHITE'S CRYSTALLINITY INFLUENCES ON ANODES ELECTROCHEMICAL PROPERTIES IN LITHIUM-ION CELLS

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The crystallinity of graphite materials used in anodes of lithium-ion cells determines the electrochemical performance of the electrodes.

Basically, it can be distinguished between the hexagonal (α-, 2H) and the rhombohedral (β-, 3R) form. Natural graphites are reported to contain up to 30 % of the thermodynamically less stable β-modification. During processing the material's crystallinity can be changed. Mechanical treatment especially milling enlarges the amount of the rhombohedral phase, while thermal annealing procedures convert the material to the more stable α-form.

Mechanical prepared graphites show a superior electrochemical behaviour. Compared to all-hexagonal graphites they are less vulnerable to co-intercalation of solvents [1,2], and also have a better passivation behaviour during the formation of the SEI (solid electrolyte interface) in the first charging step as we could show recently [3]. Figs. 1-2 show for example experiments performed in the solvent mixture of 1M $LiClO_4$, EC:DMC (dimethyl carbonate).

The favourable properties of graphites with high amounts of rhombohedral phase are attributed to the disordered structure/surface resulting from the mechanical treatment procedures. The structural defects inhibit co-intercalation of solvent molecules and provide a good anchoring of the SEI.

A direct correlation of the degree of disorder with the content of β-phase is not possible, additionally XRD (X-ray diffraction) measurements allow only rough estimations of the phase contents. Further insights into the structure of the investigated materials are won by high resolution electron microscopy investigations and Raman spectroscopy measurements.

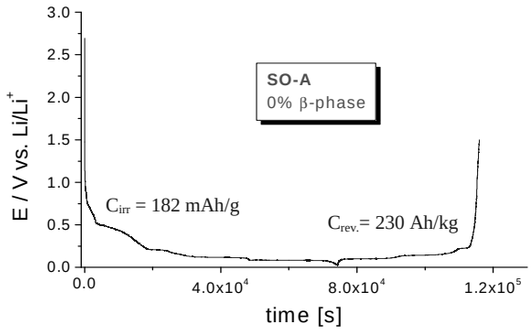

Fig. 1: 1st constant current charge/discharge cycle of SO-A graphite in 1M $LiClO_4$ in EC:DMC (1:1, w:w) as electrolyte. i = ± 20 mA/g.

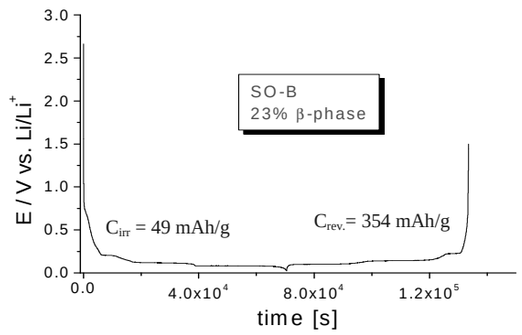

Fig. 2: 1st constant current charge/discharge cycle of SO-B graphite in 1M $LiClO_4$ in EC:DMC (1:1, w:w) as electrolyte. i = ± 20 mA/g.

References

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