INFLUENCE OF SUBSURFACE STRUCTURES OF GRAPHITE ON THE ANODE PERFORMANCE IN LITHIUM-ION CELLS

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Using graphite as anode material in lithium-ion cells, the materials crystallinity determines its electrochemical behaviour. The crystallographic rhombohedral phase can be used as an indicator for the crystallinity properties of graphite. Due to the processing history a high rhombohedral content is associated with structural and surface defects. These are causing an increased resistance against co-intercalation of solvents and also promise an effective SEI formation.

Introduction

The usability of graphites in many technical or chemical applications is determined or at least influenced by its crystallinity. Basically it can be distinguished between the two crystallographic modifications, the hexagonal or α-form, stacking sequence ABAB.., and the rhombohedral or β-phase, stacking sequence ABCABC... Normally both forms coexist, some graphites contain up to 30 % of the thermodynamically less stable β-form.

During processing the graphite's composition is changed. Using heat treatment procedures the material can be converted to the hexagonal form, while mechanical treatments increase the amount of the rhombohedral phase and also create a large number of structural and surface defects [1, 2].

Graphite crystallinity

The content of the crystallographic rhombohedral phase of graphite is an indicator for the crystallinity properties which determinate the electrochemical behaviour. Unfortunately the estimation of the two crystallographic modifications from XRD spectra remains unsure as the responsible diffraction planes are rather nonsignificant. Also by heat treatment of an electrochemically preferable "rhombohedral" graphite, the good electrochemical properties vanish before a decrease of the crystallographic rhombohedral phase can be observed. This effect is explained by the structural and surface defects vanishing before the graphite layers themselves are rearranged [3].

Graphite characterisation

Beside XRD spectra of electrochemically well performing graphites also electron microscopy investigation are very enlightening. However only a qualitative assertion to the crystallinity properties is possible. More information can be won using Raman-spectroscopy as described by Guerin et al. [3].

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References

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