Li Insertion Behaviour of Rutile TiO_2 Nanorods as Anode Material in Lithium-Ion Batteries

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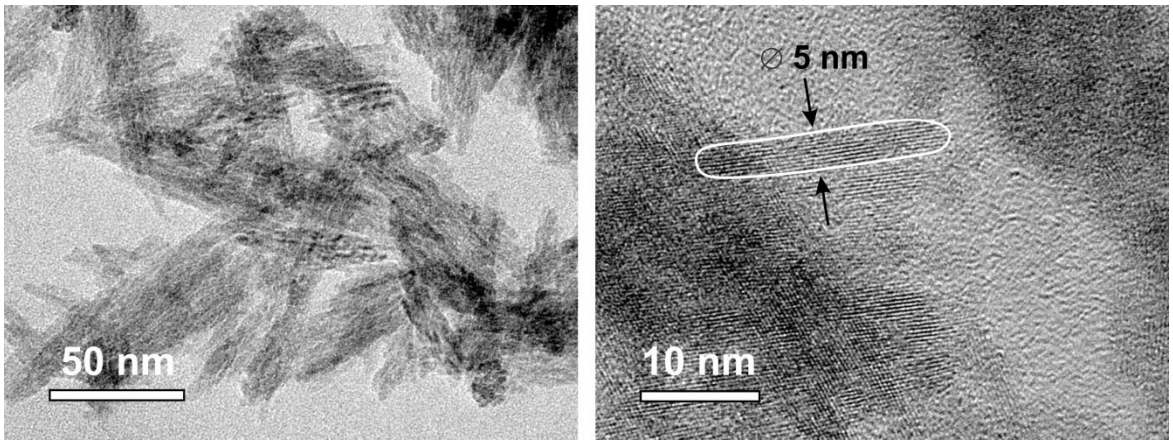
Nanocrystalline transition metal oxides have been intensively studied as promising anode materials in secondary lithium-ion batteries (LIBs) [1]. Compared to their coarse grained counterparts the increased electrochemical performance, resulting in high reversible capacities, is due to the large specific surface area and pore volume. This is beneficial for long-range transport because it reduces both the diffusion lengths of electrons and lithium ions. Besides small volume expansion during Li insertion, the 1D nanostructure of the nanorods investigated might be beneficial for the performance of the anode material in LIBs [2].

After structural characterization of the commercially available TiO_2 nanorods (rutile) by XRD and HR-TEM, Li half-cells were assembled under Ar gas atmosphere by taking advantage of the Swagelok-technique. Depending on the preparation and final composition of the electrode as well as the charge/discharge rate applied (0.1 C … 1C), capacities of up to 250 mAh/g (0.1 C) can be obtained. Starting with an initial value of 200 mAh/g at a rate of 1C, the capacity reaches ca. 150 mAh/g after 100 cycles. Besides galvanostatic cycling, cyclovoltammetry was used to study the Li insertion behavior of the active material. The measurements will build the basis for a systematic analysis of Li ion dynamics in the Li_xTiO_2 nanorods via ^{7}Li solid-state NMR spectroscopy, see ref. [3] for preliminary results obtained earlier.



(HR)-TEM images of TiO_2 nanorods investigated electrochemically. The rods show lengths in the order of 20 to 30 nm; the mean diameter is approximately 5 nm.

References

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