Lithium-ion batteries are widely used as power sources in various applications. However, a further improvement of the battery performance, such as cycle life or efficiency is desirable, which is mainly determined by the microstructure of the electrode material and side reactions with the electrolyte. With regard to further optimization a fundamental understanding of the influence of the microstructure on the ionic and electronic transport pathways in the active cathode material is necessary. In the presented work the partial conductivities of the cathode material NCM-111 were determined for single secondary particles with a diameter between 20 and 40 µm and for sintered pellets without the addition of conductive additives. NCM-111 was chosen as reference cathode active material, as its conductivities are high enough to perform impedance measurements even on single particles without encountering too high impedances.

As an active material for LIBs, Li(Ni0.5Co0.2Mn0.3)O2 (NCM-111) single secondary particles sintered at 900 °C[1] were investigated. Secondary particles have been contacted individually enabling electrochemical impedance spectroscopy (EIS) as well as polarization measurements.

The EIS results on single secondary particles imply a correlation between the total resistance and diameter of the secondary particle. By using a simple model, it was possible to estimate the electronic conductivity of NCM-111 secondary particles, which had been sintered at 900 °C, to (0.52 ± 0.12) µS cm⁻¹. This estimation is in good agreement with the results of A. Amin on compact pellets[2] and our own measurements.

Ion blocking electrodes were used to determine the ionic and electronic conductivities of the pellets. The equivalent circuit for (partially) blocking electrodes on mixed conducting materials proposed by Maier et al.[3] was used to fit the obtained impedance spectra.

As shown below, the resulting conductivities strongly depend on the porosity of the samples, while the same activation energy is found for all pellets.

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**References**

[2] SEM investigation performed by Markus Osenberg, Department of Materials Science and Technology, Technische Universitaet Berlin (markus.osenberg@tu-berlin.de).