Ultrafast laser structuring of $Li(NiMnCo)O_2$ electrodes for lithium-ion batteries

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Abstract

The growing demand for lithium-ion batteries with high power density and high energy density for electrical vehicles and stationary applications requires the development of new active materials, electrode architectures and the use of innovative manufacturing strategies. Further improvements of cathode materials such as $Li(NiMnCo)O_2$ (NMC) are of main interest in the field of industry and application-oriented research. Within this study, cathode materials consisting of 80-95 wt% active material, 2.5-7.5 wt% Timcal Super C65 and 2.5-7.5 wt% polyvinylidene fluoride binder were manufactured.

In a first approach, NMC composite cathodes were coated onto 20 µm thick aluminium foil and subsequently calendered for achieving well-defined film thicknesses in the range of 20-100 µm. Ultrafast laser micromachining for modification and formation of three-dimensional (3D) architectures in cathode materials was applied. The goal was to achieve high mass loading and improved lithium-ion diffusion properties by 3D microstructures.

The element distribution of unstructured NMC cathodes was analyzed by using Laser-Induced Breakdown Spectroscopy (LIBS) in order to investigate the lithium distribution in unstructured NMC electrodes at different state-of-charges. First results achieved from post-mortem studies using LIBS will be presented.