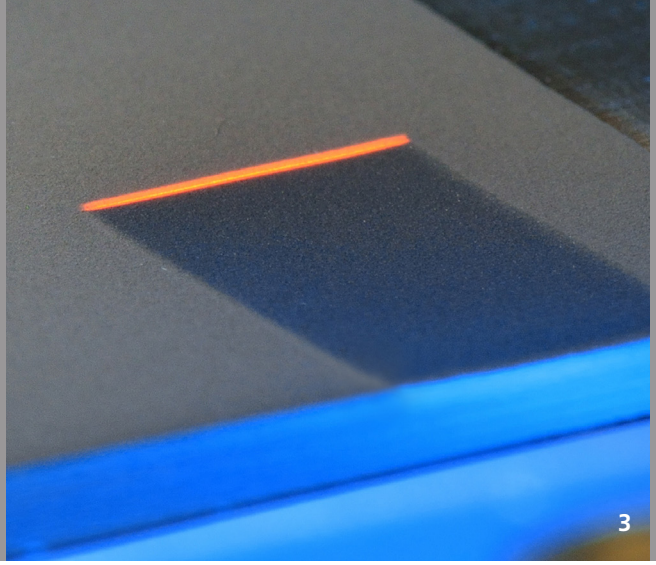

LASER SINTERING OF PRINTED CERAMIC SOLID-STATE BATTERY LAYERS FOR ELECTROMOBILITY

Task

Electromobility is regarded as a climate-friendly and sustainable concept. Requirements for corresponding battery systems are, for example, high energy densities to achieve long ranges with high safety standards. Compared to conventional lithium-ion batteries (LIB), ceramic solid-state batteries have a higher theoretical energy density and do not need organic liquid electrolytes. Thus, they are of considerable relevance and show great potential for the future of electromobility. Possible ceramic materials include lithium cobalt oxide (LCO) as a cathode material, and lithium lanthanum zirconate (LLZ) as an electrolyte material. Thin-film battery cells based on these materials cannot be sufficiently functionalized in the furnace due to long interaction times, the resulting diffusion effects as well as temperature incompatibilities of the materials.

Method

Fraunhofer ILT is developing a laser-based process for sintering particulate ceramic thin films from LCO and LLZ in the µm range. By combining screen printing and laser processes, the institute is building a battery half cell consisting of a metallic current collector, a mixed cathode layer (LCO and LLZ) and an electrolyte layer (LLZ). The short-time high-temperature laser sintering (approx. 1000 °C process temperature) has to generate adhesive layers as dense as possible while at the same time maintaining the electrochemical layer properties. Line laser beam sources make it possible to scale up the inline process.

Results

Laser radiation can be used to adhesively sinter printed mixed cathode layers (< 10 µm) on metallic current collectors, which, in contrast to oven-processed layers, show a high crystallinity of the base materials. They also exhibit a reduction of the minor phases and are, thus, the necessary prerequisite for use in a battery cell.

Applications

In addition to its use for battery cell production in the mobile energy storage sector, the process presented here can also be applied to sinter other microparticulate layers.

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3 Laser sintering of a mixed cathode layer on a current collector foil using a line laser beam source.