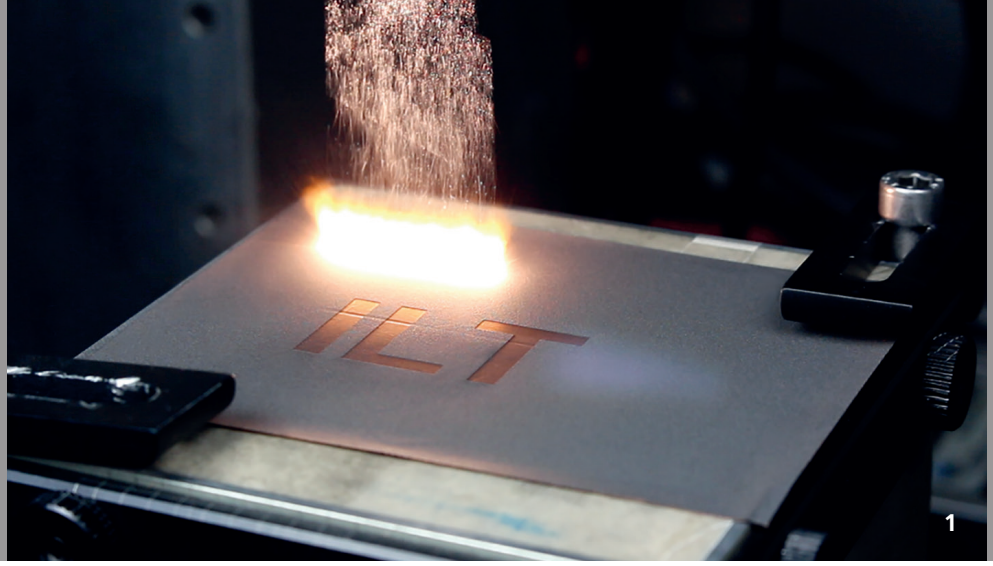

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FLEXIBLE BATTERY DESIGN THROUGH HIGH-RATE LASER ABLATION

Task

As battery-powered electronic devices increasingly penetrate markets and as new areas of application are developed for them, there is a constant demand for lithium-ion batteries with different geometrical shapes. While battery manufacturers need to increase productivity, they are also confronted with the challenge of producing a wide variety of cell formats on a single production line. The coating of the metallic carrier film, which is only a few micrometers thick, with the so-called active material constitutes a central production step. Since the electrodes are subsequently contacted via so-called tabs, parts of the metal foil must remain uncoated, which means the coating process has to be interrupted and restarted repeatedly. What is needed, therefore, is not only a faster, but also a more flexible electrode production.

Method

One approach to solving this problem is to coat the entire surface of the film instead of coating it partially, which is technically very complex, and then use a laser to selectively expose the areas required for electrical contacts. Until now, this idea has failed because the laser ablation process was not productive enough. In addition, the quality of laser ablation with short pulse lasers did not meet the high demands placed on a contact point that could be welded reliably. To solve this conflict of goals, Fraunhofer ILT uses a powerful ultrashort pulse (USP) laser. The challenge here is to remove the entire layer of active material without leaving any residue in just one pass and without damaging the thin metal foil.

Results

The process developed by Fraunhofer ILT can remove graphite-based anode material from a 10-micrometer-thin copper foil at a rate of up to 1,760 mm^3/min without damaging it. With today's common active-material layer thicknesses, this corresponds to an area rate of about 4 cm^2/s. In the near future, it will be possible to increase the ablation rates even further by using the new generation of USP laser systems with multi-kW output powers, such as those currently being developed in the Fraunhofer Cluster of Excellence Advanced Photon Sources CAPS.

Applications

Highly productive USP laser ablation is particularly attractive for battery cell manufacturers. This flexible manufacturing process allows non-standard cell formats to be produced in an extremely productive manner. Such batteries are predominantly used in portable electronic end devices, where the lithium-ion battery must be adapted to the device design, which often has minimal space for the battery. In addition to use in the electronics industry, highly productive USP laser ablation on large areas is also of interest to the hydrogen or automotive industries.

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1 Selective ablation of graphite anode material from a 10 µm thin copper foil.

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