Laser-based separation of battery electrodes

Laser-based cutting processes are increasingly finding their way into the mass production of battery electrodes. Here, typical tasks include slitting coils, notching contact tabs and separating electrodes. Since it works without contacting the component, the laser-based process has several advantages, including the high amount of contour freedom and flexibility with varying electrode designs, as well as the high degree of automation and low maintenance intervals of the laser systems. The current challenges are to enable a high throughput with consistently high cutting quality and process stability and to integrate the laser cutting process into the sensitive production environment for electrode material.

Process and system development

To meet these challenges, Fraunhofer ILT is working with partners from industry and research to develop innovative concepts and processes for beam shaping as well as process monitoring and control, among others. For this purpose, the institute has built a laser cutting system that reproduces the essential conditions of industrial roll-to-roll production in a laboratory environment. The system can be flexibly converted, enables users to monitor processes comprehensively and evaluate throughput-optimized machine concepts. In its basic configuration, it is able to cut anode foils, for example, at a speed of 5 m/s with the highest quality. The SEM image shows the cutting quality achieved (viewing angle, 45°): The thickness of the copper foil is 10 µm, that of the coating 70 µm in each case. A single-mode fiber laser in cw operation was used. Modulated or pulsed radiation is used for small contours or more demanding materials. The Fraunhofer ILT application laboratory has a wide range of beam sources available to address difficult processes, from cw lasers with a modulation frequency of up to 100 kHz to ultrashort pulse (USP) lasers with 400 W power.

Safe operation at high separation speeds

In process monitoring and control, the Cutting Group at Fraunhofer ILT is focusing on generating relevant process signals that make it possible to reliably determine the process status on-line. This should make the process much more reliable at speeds just below the cut-off point.

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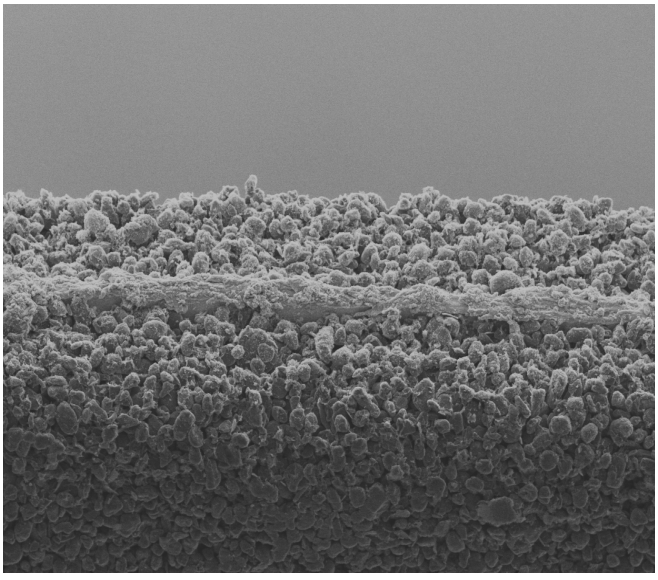

1 SEM image of the cut edge on a graphite-coated anode foil (total thickness: 150 µm).