Surface quality of slot-die coated battery electrodes with special attention to edge effects

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Introduction

Slot-die coating is currently the most common coating method for the manufacturing of lithium-ion battery electrodes [1]. An easy way of reducing production costs is to increase the line capacity. Thus, the relatively high-viscous electrode slurries have to be coated at continuously increasing velocities. Facing these higher velocities, the main processing challenge is to ensure constant surface quality and to reduce unfavorable edge effects like superelevations (*Figure 1, right*) [1].

Experimental Methods and Results

For a range of stable coating conditions, the uniformity of the wet film was analyzed and logged with a two dimensional laser sensor (*Figure 1, left*).

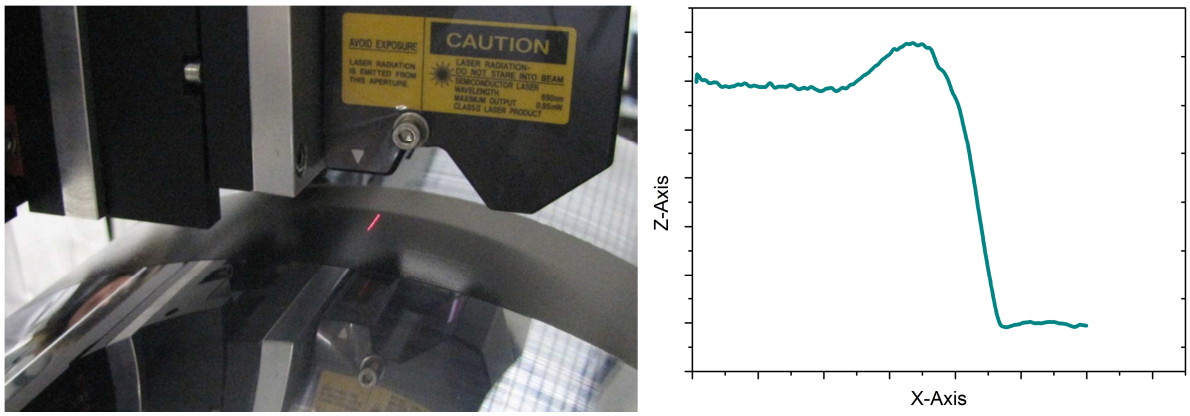

Figure 1: Left: The coated anode slurry on the backing roll is scanned right after the coating step by the 2D laser sensor.
Right: Edge-profile of a slot-die coated anode slurry, measured in the wet film with a 2D laser sensor directly after coating.

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To improve the quality and reproducibility of lithium-ion battery electrode coatings, we investigated the coating of different anode slurries consisting of large graphite particles, a polymeric stabilizer and a polymeric binder with water as solvent. Special attention was drawn to the shape of the film-edges by varying coating conditions, such as lip- and shim-geometries, coating velocities and rheological fluid properties.

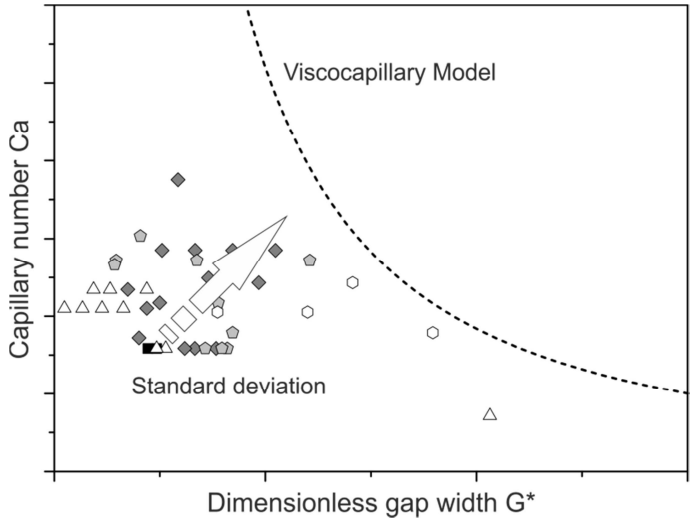

Figure 2: Process window with surface standard deviations of slot die coated lithium-ion battery anodes.

By analyzing the experimental data, the influence of the dynamic and static coating parameters on film quality could be related. At stable coating conditions, the wet film roughness increases when the stability limit - given by the viscocapillary-model [2] - is approached (*Figure 2*). Furthermore, the effect of coating parameters on edge effects like edge- or start-stop-superelevations will be discussed.

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