Intermittent Slot Die Coating for Lithium-ion Battery Electrodes

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Extended Abstract:

Lithium-ion batteries are one of the most important technologies for energy storage in electric mobility. Limiting factors are the high costs of the energy storage systems, especially the costs of the battery cells. One way of reducing the costs of lithium-ion battery-cells is to increase the manufacturing process throughput. To gain advantages in cell stacking, intermittent coating (see figure 1) of the electrodes is often used in industry but limits the production speed.

Figure 1: Anode film with 80 mm coated patterns and 20 mm non coated intersections between the patterns.

In this work, we investigate the mechanisms of intermittent slot die coating of non-Newtonian battery slurries. To enable high speed intermittent coatings up to 100 m/min, a novel technology is developed which allows for starting and stopping the slurry flow within milliseconds. Therefore, fluid

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pressure profiles are measured inside the slot die to receive information about the slurry flow. In addition, profiles of the wet film are measured for evaluation of the coating quality. Based on this information, the start-up and break-up mechanisms are discussed as well as the influence of coating speed on the quality of the start-up and break-up edges.

The used anode slurries are produced with a waterborne latex dispersion and carboxymethyl cellulose (CMC) binder-system and dispersed graphite particles as active material. Carbon black was used as conductive agent and water as solvent. The experimental set-up was build-up with a custom developed intermittent slot die technology to stop the coating flow during the interruption of the coating. The fluid is stored inside the slot die during the uncoated areas which gives advantages regarding the switching time. For analyzing the fluid pressure, a pressure transducer is integrated in the slot die. The coating was applied directly on a chromed roller without the use of substrate. The 3D-film profile was in-situ measured by a triangulation line-laser. The focus is on the film starting time until a stable fluid flow is formed, depending on the coating velocity, as well as the comparison of the produced starting edge's film build-up length.

The results showed the relation between coating speed and length of the starting and stopping edges. The ramping time is identified as one of the most critical parameters for the quality of the starting and stopping edges and therefore the quality at higher web speeds. We will also show how viscosity and solids content affect the quality of the patterns.

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