Multilayer slot die coating of Li-ion battery electrodes (Talk)

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Introduction

Slot die coating is one of the most widely used coating methods for Li-ion battery (LIB) electrodes [1]. It allows for the application of uniform layers of highly viscous electrode slurries and the promising simultaneous coating of multiple layers of different fluids [2].

The advantages of subdivided electrode layers are diverse. On the one hand additive and binder distributions could be adjusted by the combination of different slurries. This may save weight and improve the cell performance. On the other hand even different active materials could be combined well distributed in only one electrode, which also may enhance the efficiency of the later on battery.

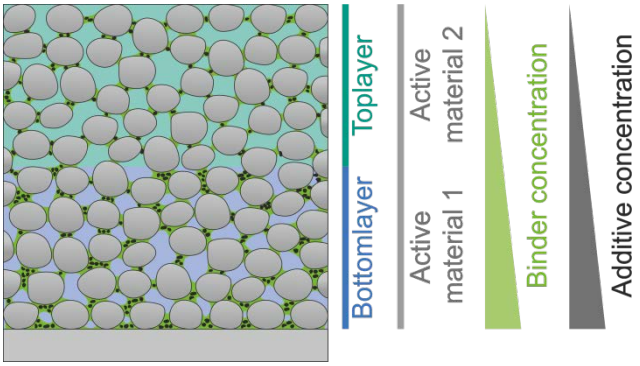

Fig. 1: Schematic drawing of a two-layer LIB-electrode with pre-distributed active materials, binder and additive components.

However, compared to other industrial applications, the coating of multiple layers is not applied on a wider scale in the field of Li-ion batteries yet. Before multilayer coatings can displace established single layer processes, along going differences regarding process limitations have to be understood.

Experimental methods and results

In previous presentations it was shown that two-layer LIB coatings offer a smaller process window compared to single layer films [3, 4]. In this work we therefore investigated the major distinctions of single and double layer coated non-newtonian fluids.

For a certain wet film thickness we computed the bead pressure in the coating gaps numerically and analytically and compared the wetting-lines to our experiments. The results show, that the analytical non-newtonian prediction for gap pressure [5] fits very well with some minor constrictions.

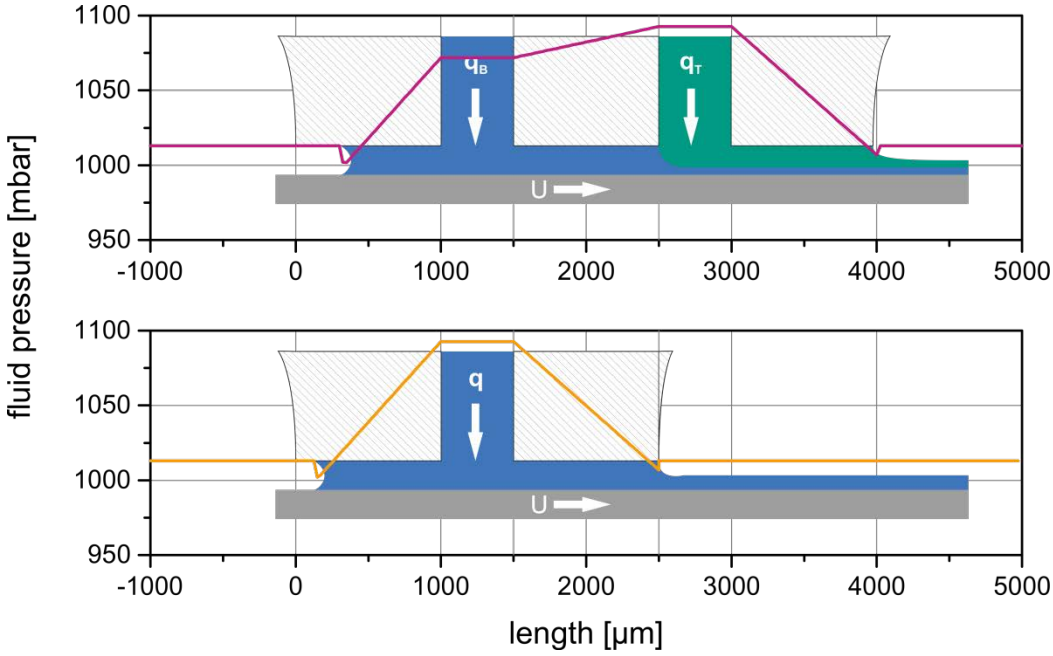

Fig. 2: Analytically calculated bead pressure for a single layer (bottom) and a two-layer LIB-electrode coating (top).

We applied this prediction to a range of coating speeds and received a process window, which confirms our earlier results. Thus the additional pressure gradient beneath the mid lip lowers the pressure plateau against the upstream pressure for the given conditions and promotes air entrainment.

In this work we furthermore assembled multilayer lithium-ion battery anodes into pouch cells and compared to them conventional anodes.

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