Measuring drying kinetics of Li-ion battery electrodes exposed to impinging gas flow

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Electrodes for Li-ion batteries, like many other functional films, are applied as wet thin film on a substrate and the solvent is removed by a subsequent drying step. For interpretation of experimental data and design of the drying process, the drying kinetics of these thin films have to be investigated. For this contribution an anode material system consisting of a particulate active material dispersed in water together with additives and a polymeric binder was coated on aluminum foil and dried under an in-house comb nozzle array.

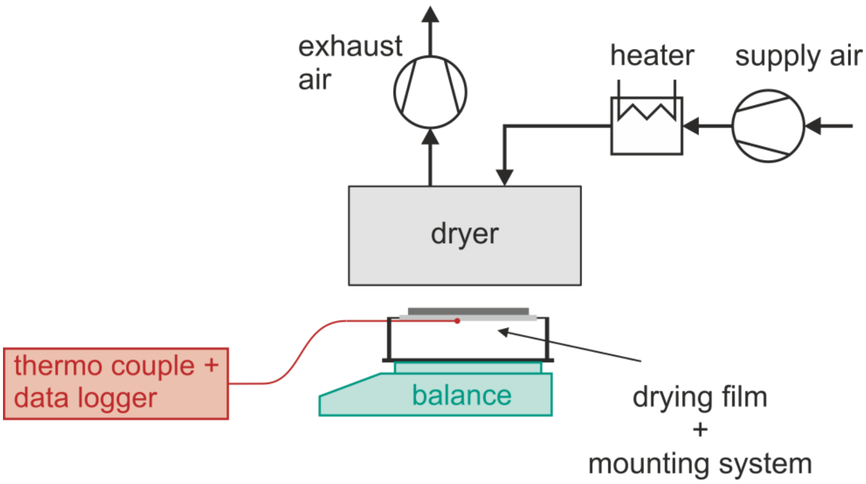

Figure 1: Schematic drawing of the experimental set-up.

For the experiments, the anode film is applied by a doctor blade onto a metallic substrate foil. The foil is mounted to small metal plates with double-sided adhesive tape at all corners and a constant tension is provided by coil springs (see Figure 1). Preheated air is directed through hexagonal jet nozzles onto the film and removed through effusion openings arranged around each nozzle [1]. The dryer geometry ensures high heat and mass transfer at a high lateral homogeneity. During the drying experiments, the mass loss was detected by a balance. The film temperature was measured by a thermocouple fixed with aluminum tape underneath the substrate foil.

In this set-up, drying curves were determined with high accuracy for drying rates relevant to industrial processing. Mass and temperature signal were used to determine the constant rate period. It was found that the drying of aqueous slurries for Li-ion battery anodes is dominated by a pronounced constant rate period even for electrodes with a considerably higher film thickness of 500 µm compared to common electrode thicknesses of < 100 µm.

References

1. P. Cavadini, P. Scharfer, W. Schabel, L. Wengeler; Device for transferring heat or mass, comprising hexagonal jet nozzles, and method for treating surface layers; WO2013045026