ENERGY

ELECTROLYTE

iwb - Institute for Machine Tools and Industrial Management

Heinz Maier-Leibnitz Zentrum

Looking inside a Lithium-ion battery

Lithium ion batteries could be used in electric vehicles and stationary energy storage solutions. However, their use for large-scale applications is limited by the scalability of existing production processes or designs. Optimising using cheaper and better methods and innovative materials could provide lower cost and better quality power for many future applications.

THE PROBLEM TO SOLVE:

Electrolyte filling is a difficult and critical step of battery production that has a huge impact on cost and quality. Visualising this process helps manufacturers to understand how to improve it but the casing of the battery is opaque to many existing imaging techniques making in-situ observations difficult.

A STEP TOWARDS THE SOLUTION

Scientists of the Institute for Machine Tools and Industrial Management and the Maier Leibnitz Zentrum (MLZ) in Garching, Germany are investigating this problem with neutrons. Neutrons are non-destructive and can "see through" heavy materials, such as those that encase a battery. Neutrons are particularly sensitive to light elements such as lithium or hydrogen atoms present in electrolytes so they are perfect for in-situ imaging of batteries.

The electrolyte filling process was studied using pouch bag cells with Neutron Radiography (NR) on the ANTARES instrument at MLZ (Fig. 1). The flow of the liquid as it filled the cell was visualised over time.

THE RESULT

Neutron Radiography successfully visualized the **2D macroscopic wetting** between the layers of the components and the flow paths of the electrolyte during the filling process. In the images, the electrolyte appears dark so non-wetted areas are brighter (Fig. 2). Gas entrapments could also be seen.

The combination of NR and other measurement techniques provide information on necessary wetting time during production which is important for industrial processes.

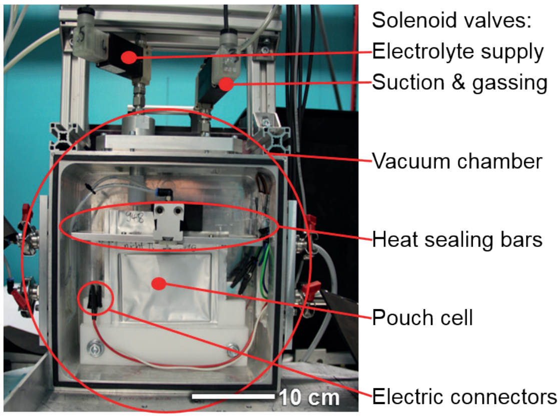

Fig. 1 Section of the filling station at the neutron radiography instrument ANTARES of MLZ. Ref: Günter et.al.

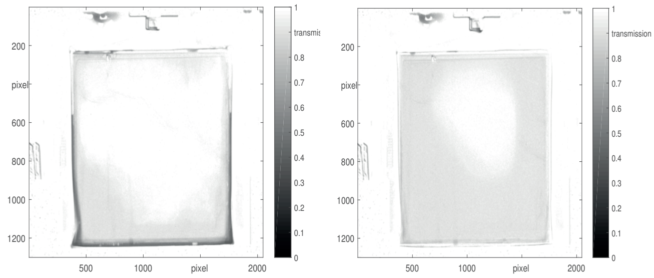

Fig.2 Neutron Radiography images of the pouch cell at 2.5 minutes (left) and 60.5 minutes (right). The deeper gray colour represents a lesser intensity of neutrons and thus a larger amount of electrolyte in that part of the cell. Ref: Günter et.al.

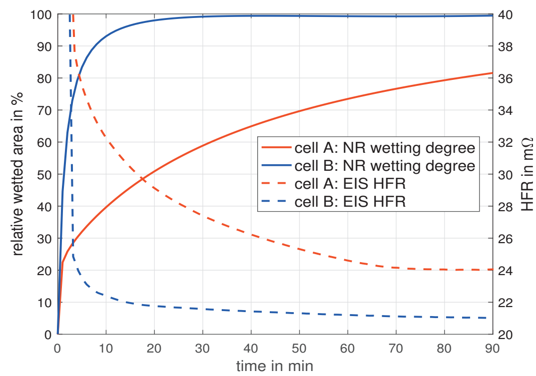

Fig.3 Comparison of NR wetting degree area and Electrochemical Impedance Spectroscopy HFR over time of two cells tested (A and B). Comparing these complementary techniques reveals that microsopic wetting of electrolyte into the pores is dependent on the macroscopic wetting. Ref: Günter et.al.

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References:
Günter et.al. J. Electrochem. Soc., **165** (14) A3249-A3256 (2018).

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