Material Characterization and Quality Control of Lithium-Ion Battery and Fuel Cell at Multiscale level using 3D Image Data

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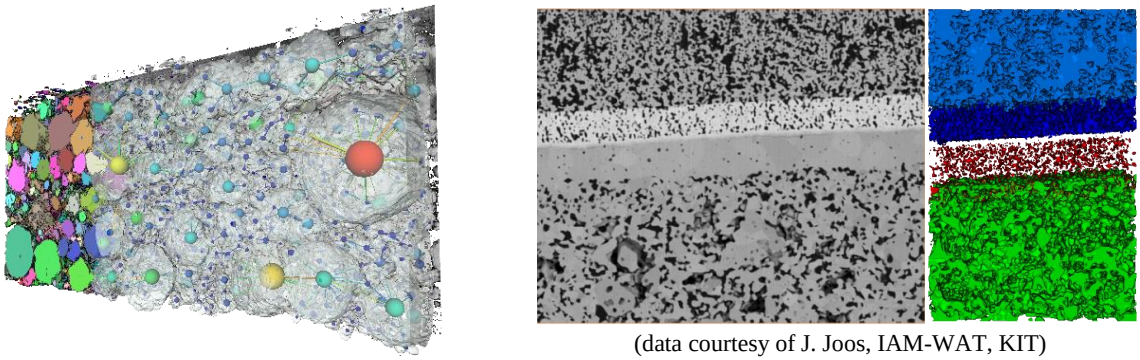
The research and development of batteries and fuel cells can benefit much from imaging. From X-ray Tomography to TEM, FIB-SEM, including recent Plasma FIB, images can be acquired to display the whole assembly, down to the microstructure of the materials. Thermo Scientific™ Avizo Software (Thermo Fisher Scientific, Waltham, MA, US) allows for visualizing, processing, and quantifying such data in a controlled, robust and reproducible manner, and can therefore help at all stages: from material research, optimization of their properties, to the manufacturing and quality control of the production.

Thanks to advanced image processing and segmentation techniques, Avizo software makes it possible to segment the different phases and extract key parameters of the microstructure of the involved materials [1,2]: volume fractions, but also surface areas of the different interfaces, extraction and quantification of triple phase boundaries. Built-in separation algorithms enable partitioning and modeling the pores or particles into networks of interconnected objects, and properties like absolute permeability or tortuosity can be estimated. Geometrical models or meshes can be exported into third-party software for further numerical simulations.

Besides materials microstructure, the whole assembled product needs to be controlled. Again, image analysis can bring valuable insights about the manufacturing processes and quality control. Dimensions and thickness of the different layers, integrity of contacts, connectors, case, or even evolution of the structure during standard operating conditions or specific experiments [3] may be carried out thanks to the software functionalities in terms of advanced image processing, dimensional measurements, data alignment and digital volume correlation.

The poster will illustrate and detail such applications of the Avizo software to characterize and analyze battery and fuel cell materials and assemblies.



(data courtesy of J. Joos, IAM-WAT, KIT)

Figure 1. (left) Connectivity of active material inside a cathode of a Li-Ion battery. (right) Layers and corresponding pore spaces from anode to cathode. Both using using Plasma FIB imaging

References:

[1] X. Lu, T.M.M. Heenan, J.J. Bailey, T. Li, K. Li, D.J.L. Brett, P. R. Shearing, J. Power Sources 365 (2017)
[2] J.A. Taillon, C. Pellegrinelli, Y.L. Huang, E.D. Wachsman, L.G. Salamanca-Riba, Ultramicroscopy 184-A (2018)
[3] T. Bondz, J. Zhou, J. Cutler, J. Electrochem. Soc., 164-1 (2017)