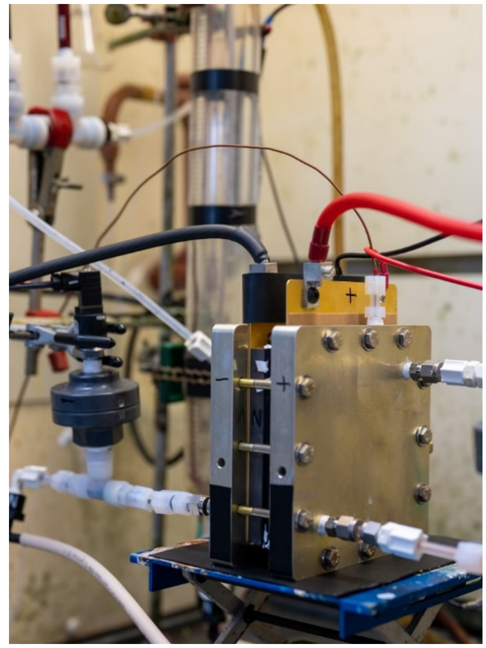
Electrosynthesis

Optimizing Battery Performance

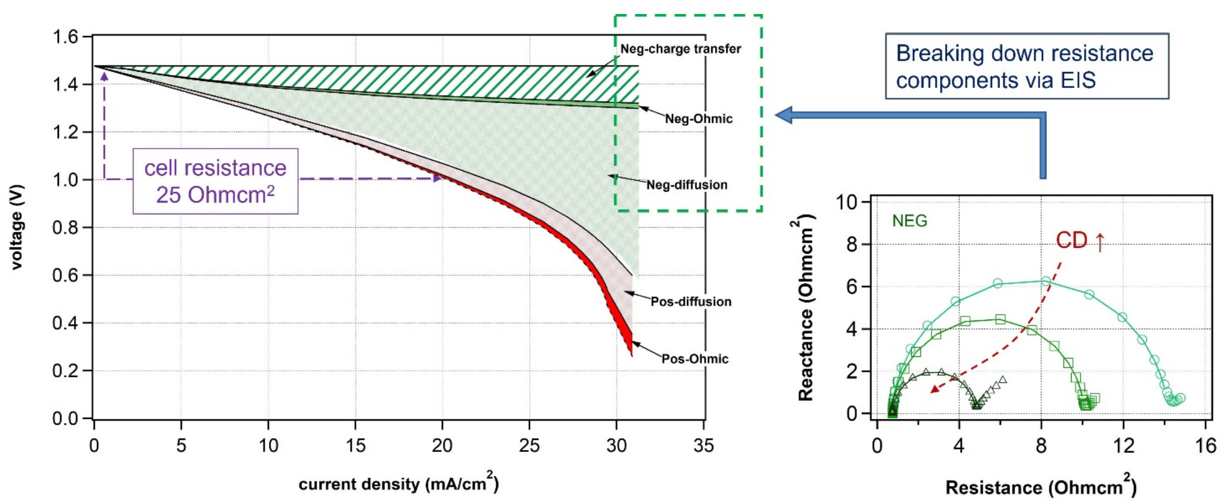
Electrosynthesis Company has been developing and supporting the commercialization of redox flow battery technologies for more than 30 years. One of our key developmental tools is to test single cell batteries (as shown in photo) leading to cell stack testing at scales ranging from 10 cm^2 (laboratory) to 0.7 m^2 (commercial). The results of such testing help us screen and validate battery components, design-based performance, and stability.



Battery cells comprise various materials assembled in layers including bipolar/flow field plates, electrodes, gaskets, and membranes. Each component has its own role to make the battery operational and each will contribute to the internal cell resistance. A high performing battery will require the cell resistance to be as small as possible!

Our first step to reduce the cell resistance is to understand the composition of it. One of our skills is to diagnose the battery cell *in-situ* and identify the factor(s) limiting the battery performance using electrochemical impedance spectroscopy (EIS). Understanding the dominating factor(s), will facilitate how to improve the battery performance.

The following illustrates this optimization:

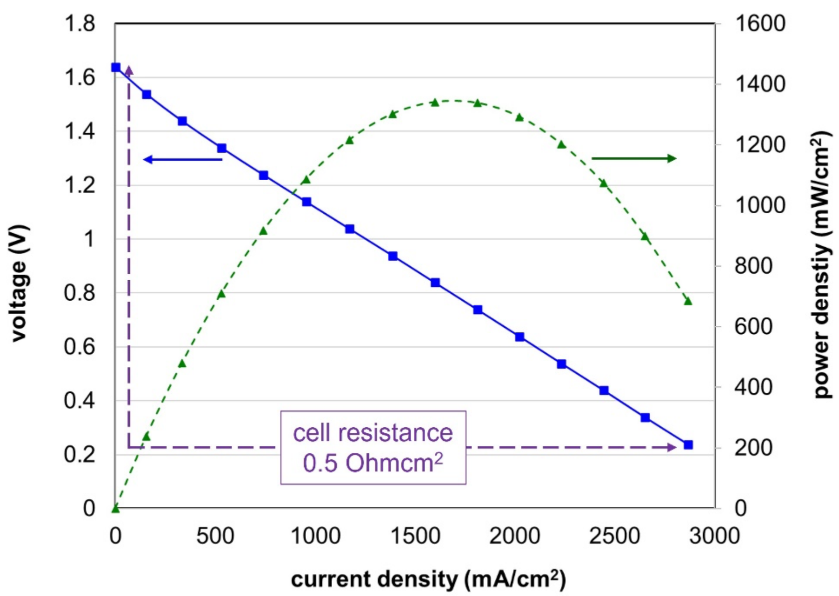


With EIS (and a reference electrode in this case), we were able to break down all the losses individually and quantitatively. As shown in the graph, the main contributor to the voltage loss in this battery cell was the processes on the negative side (green color).

Breaking down the processes of the negative side further, we learn that the charge transfer and the diffusion resistances were the two main components limiting the battery performance.

This observation suggested that the properties of the negative electrode and the operating conditions would need to be improved in order to facilitate the charge transfer and diffusion process and increase the overall battery performance.

By optimizing those factors, the battery performance showed drastic improvement (from 25 Ω cm^2 in the example above) to 0.5 Ω cm^2, as shown in the graph below, which resulted in an improvement in the achievable current density by almost two orders of magnitude.



EIS is a powerful tool for diagnosing battery cells. However, every battery is unique, and expertise is required to perform the measurement and interpret the results properly. Electrosynthesis Company would be more than happy to work with you and improve the materials, design, and performance of your redox flow battery! Please contact us at Info@electrosyntheis.com.