Electrochemical impedance spectroscopy (T19)

- Frequency response of battery cell to an electric signal (frequency sweep)
  - Voltage imposed, current measured (PEIS)
  - Current imposed, voltage measured (GEIS)
  - Intermediate approach (A-GEIS)
- The break-down of the total impedance of the cell permits to obtain information about contact and electrolyte resistance, charge transfer and interfacial resistances, transport limitations.

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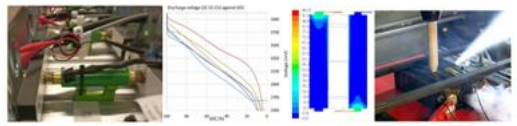
Draft White Paper

Test methods for improved battery cell understanding

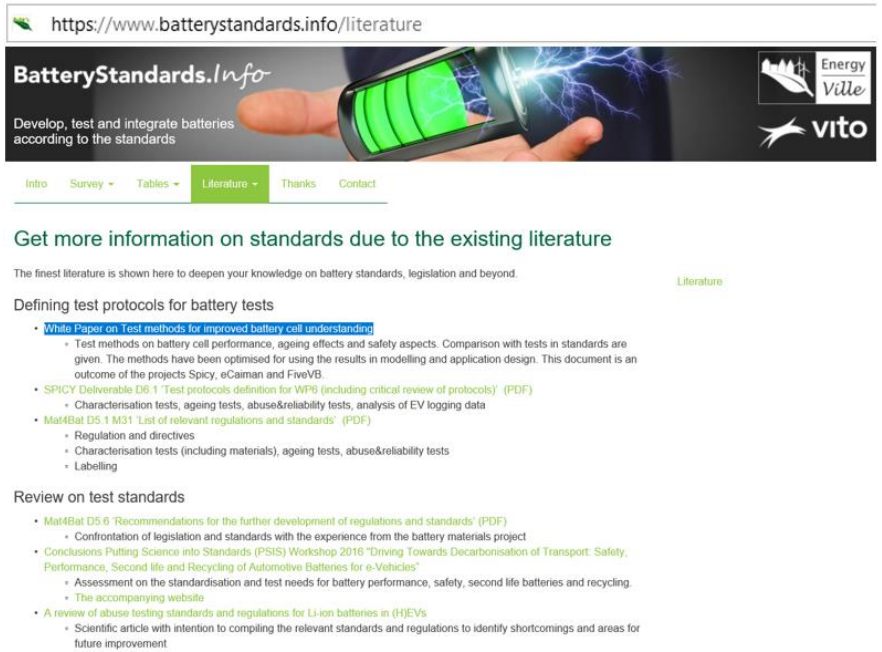
Version 2.5



R&D Status: Advanced

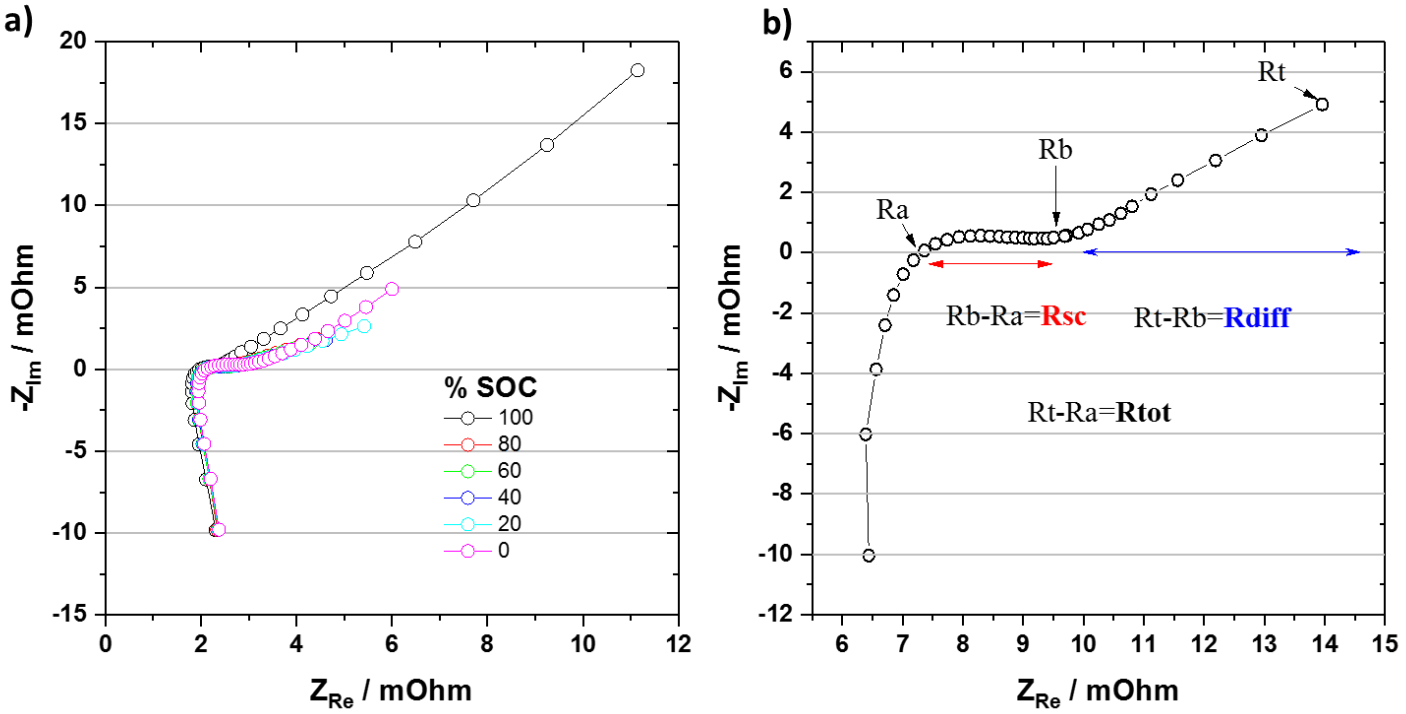
EUROPEAN COMMISSION eCAIMAN SPiCY Innovative Battery Five VB

The research leading to these results has received funding from the European Community's H2020 Research Programme under grant agreement n° 653331/eCAIMAN, n°653373/SPICY and n°653531/FiveVB.

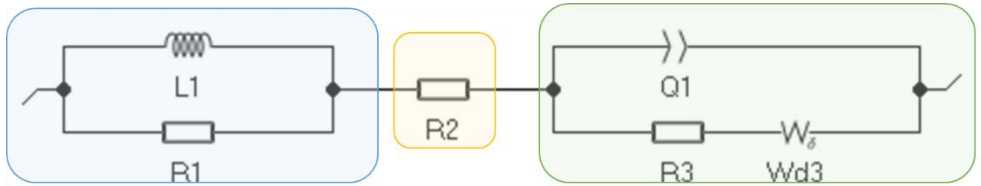


Electrochemical impedance spectroscopy

- Frequency response of battery cell to an electric signal (frequency sweep)
  - Influence of SOC
  - Influence of age (SOH)

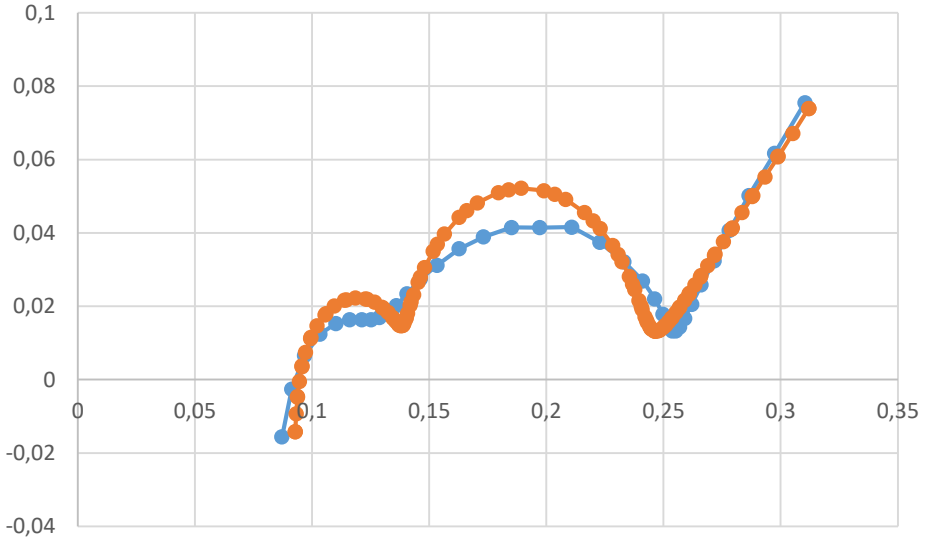


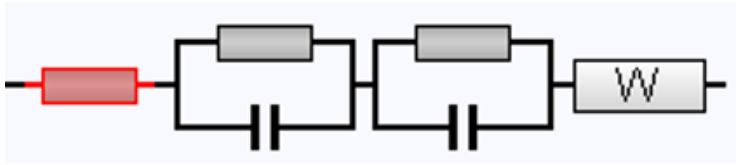
R&D Status: Advanced



Electrochemical impedance spectroscopy

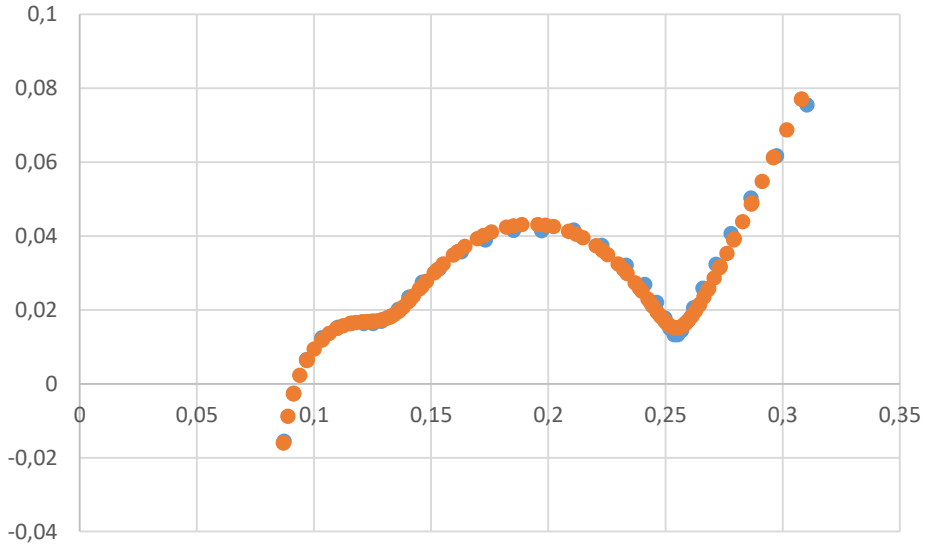
- Frequency response of battery cell to an electric signal (frequency sweep)
  - Measurement versus fit model



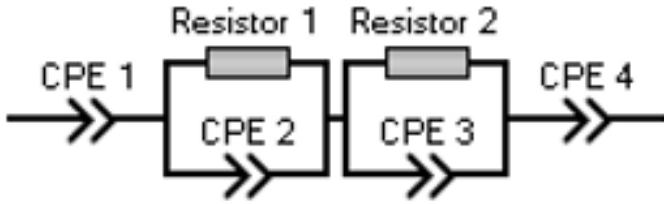


RelaxIS 3
Impedance Spectrum Analysis

R&D Status: Advanced



Model:
P-(R)(P)-(R)(P)-P



SSR:
0,0003915

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Electrochemical impedance spectroscopy

What can we characterize : cells

Experimental time: 1 day or longer

Advantage: a way to observe material properties just by the cell potential excitation.
Ageing behaviour can be derived.
It becomes a method to estimate SOH.

Drawback: Response quite dependent on cell type and certainly on cell size.

R&D Status: Advanced

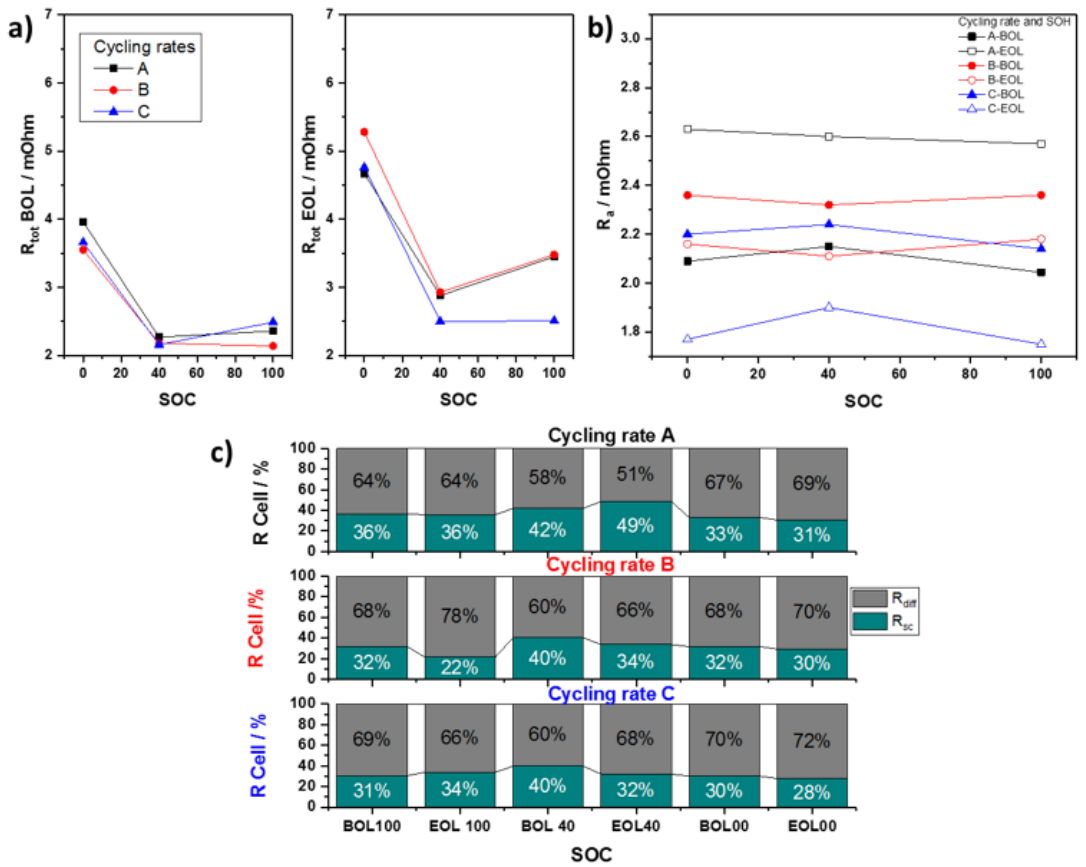

Figure 22: Example of qualitative analysis results. The cells were aged at different cycling rates. BOL and EOL express the SOH while the number the SOC at which the EIS spectra was measured.