Example 1

EIS on different cathodes materials and carbon black

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Electrochemical cell designs

2 Electrode Setup

- *Counter electrode: Li metal*

Pouch bag cell

3 Electrode Setup

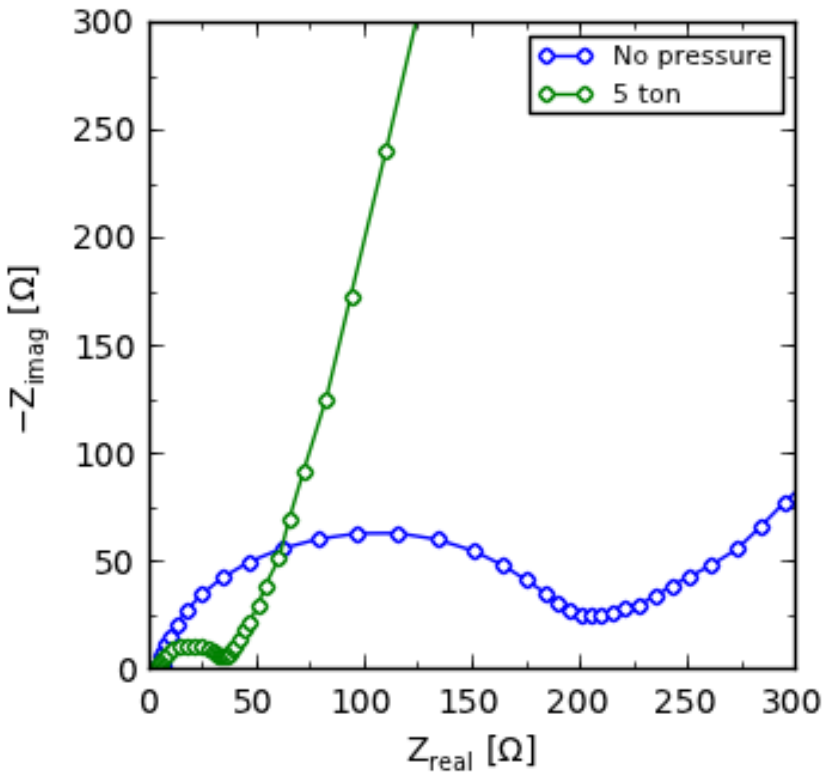
- *Counter electrode: Li metal*
- *Reference electrode: Li metal*

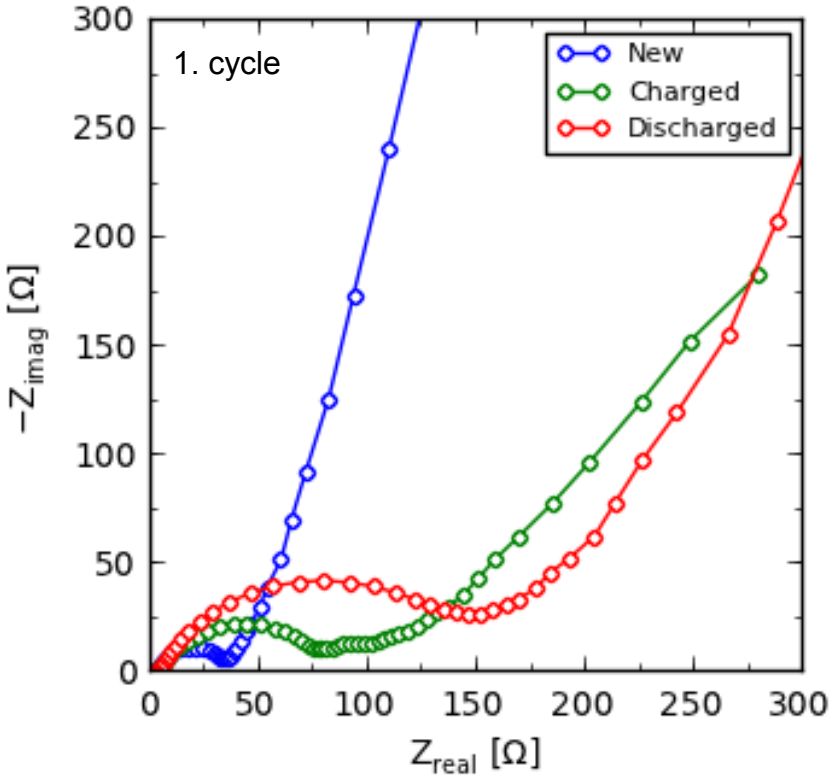
”Beaker”-type cell

EIS of different cathode materials

LiMn0.5Ni1.5O4

Cathodes with and without compression (role press)

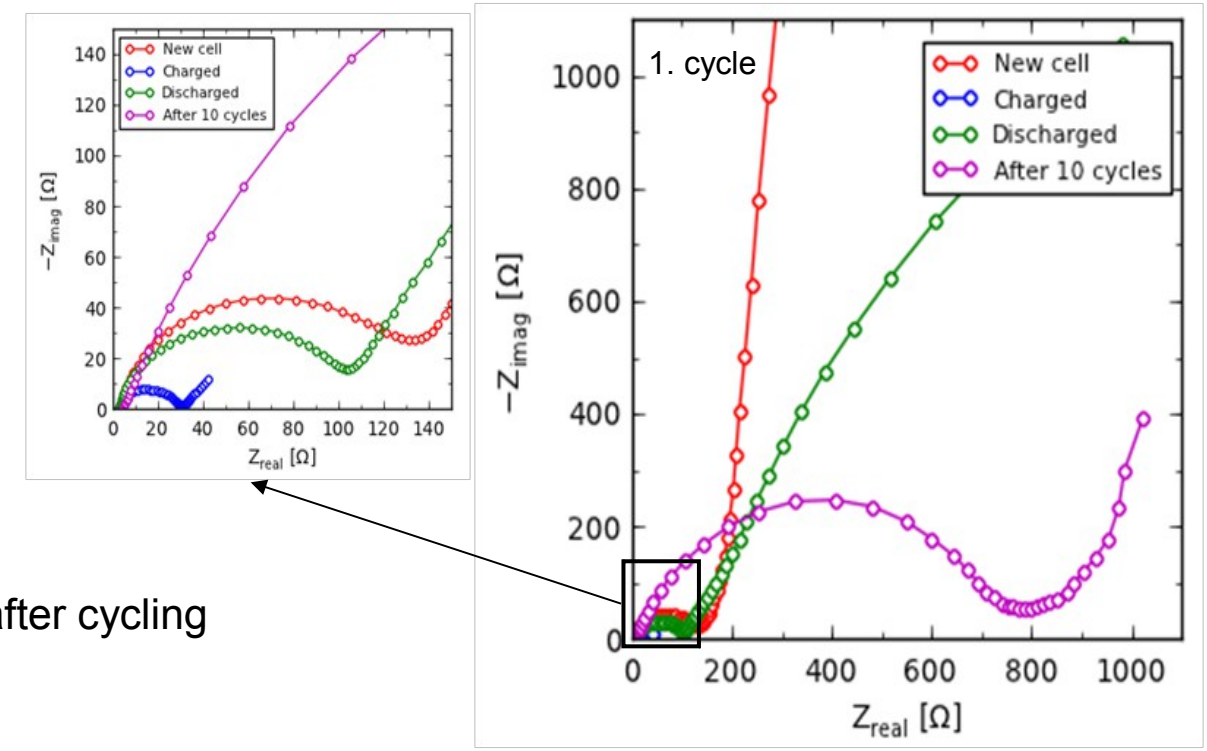




Decrease in M-M distance when charged – <u>lowest resistance when charged</u>

EIS of different cathode materials

LiCoO2



Increase in resistance after cycling

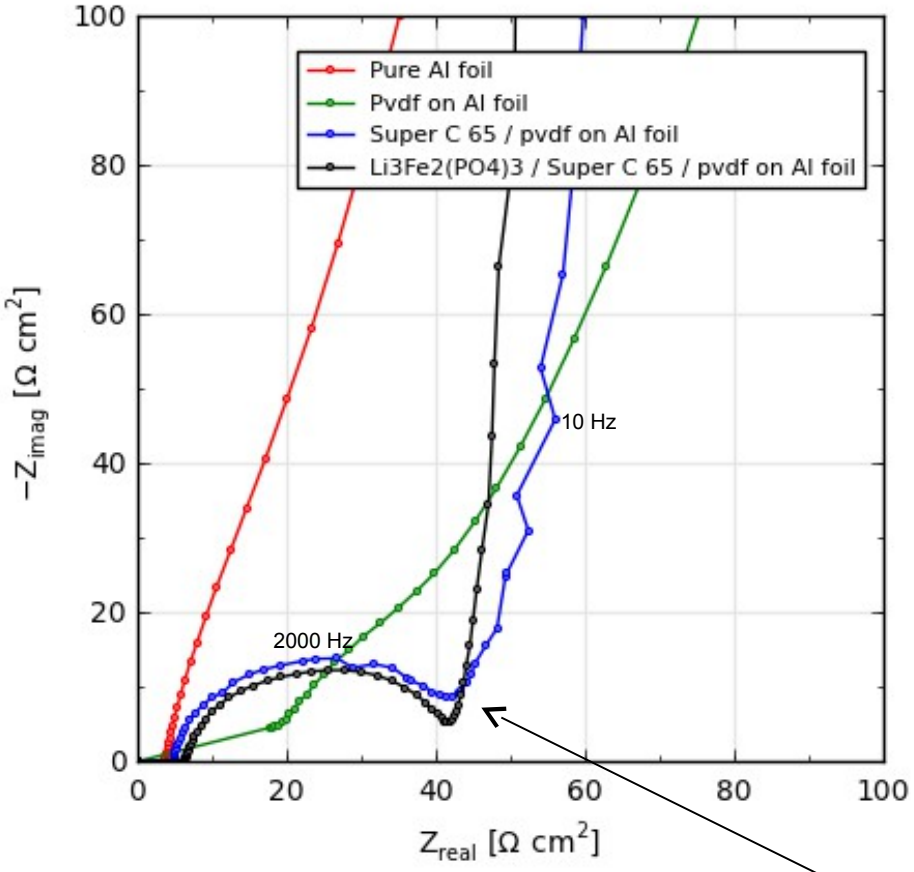
First cycle are different:

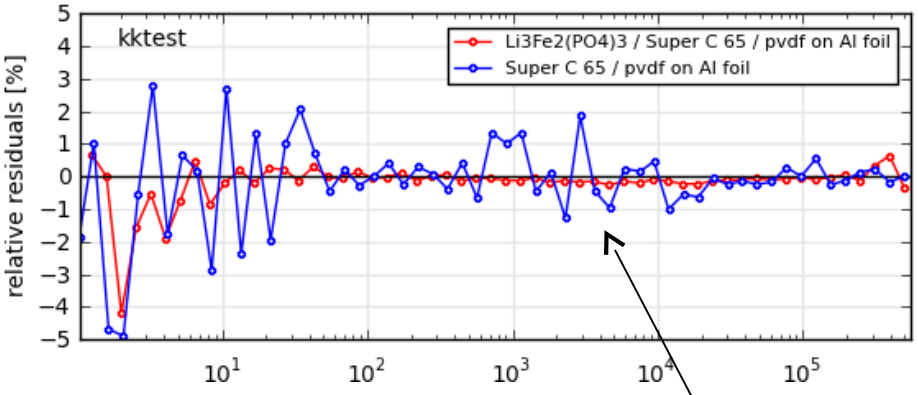
- Formation of SEI layer on anode
- Possibly better electrolyte filling in the pores after first charge

Cycle the battery a few times before EIS interpretation on charge/discharged states

Carbon black

Super C 65 + pvdf binder (on Al foil)





Data validation by Kramers-Krönig:

- Should be optimized for Super C 65 sample

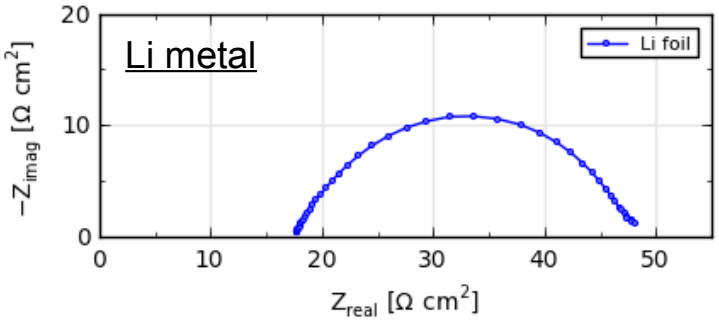
Same respond from carbon black alone!

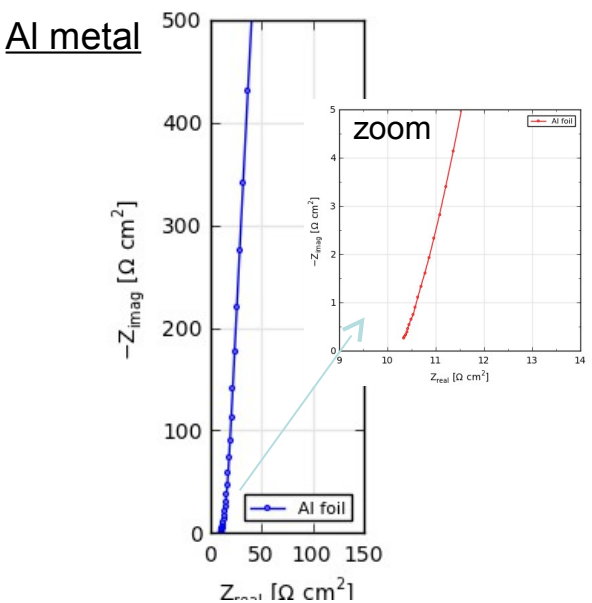
3 electrode setup

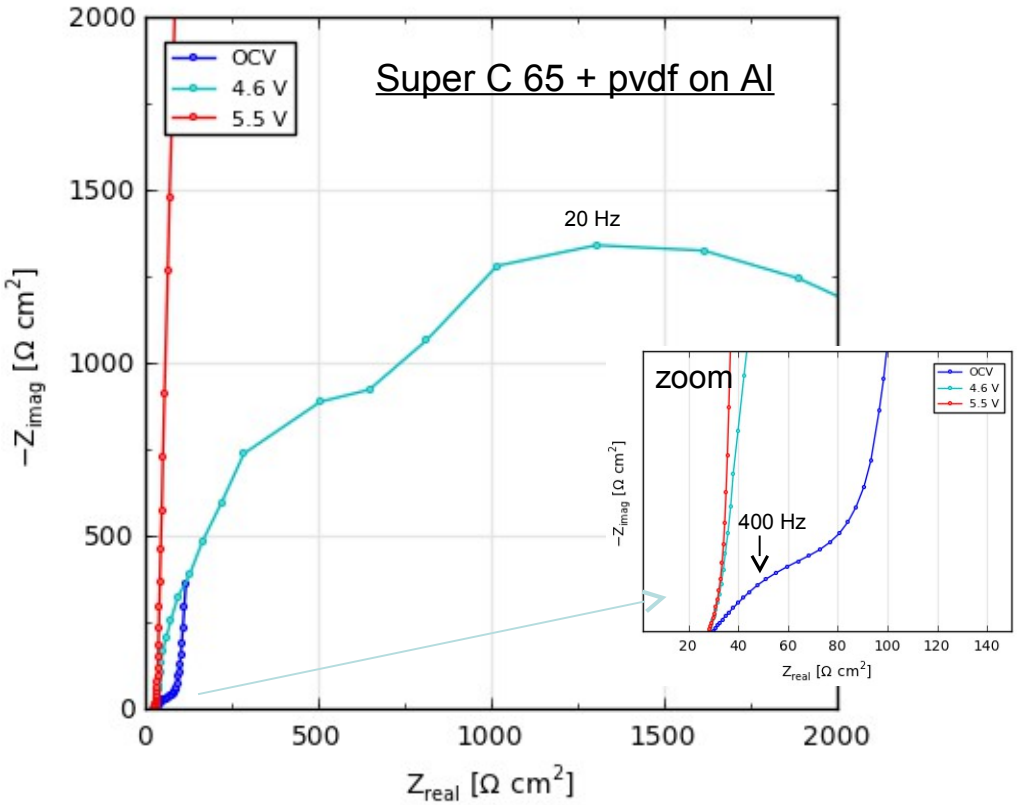
Counter and reference electrodes: Li metal

Why do we see this change?

Working electrode:



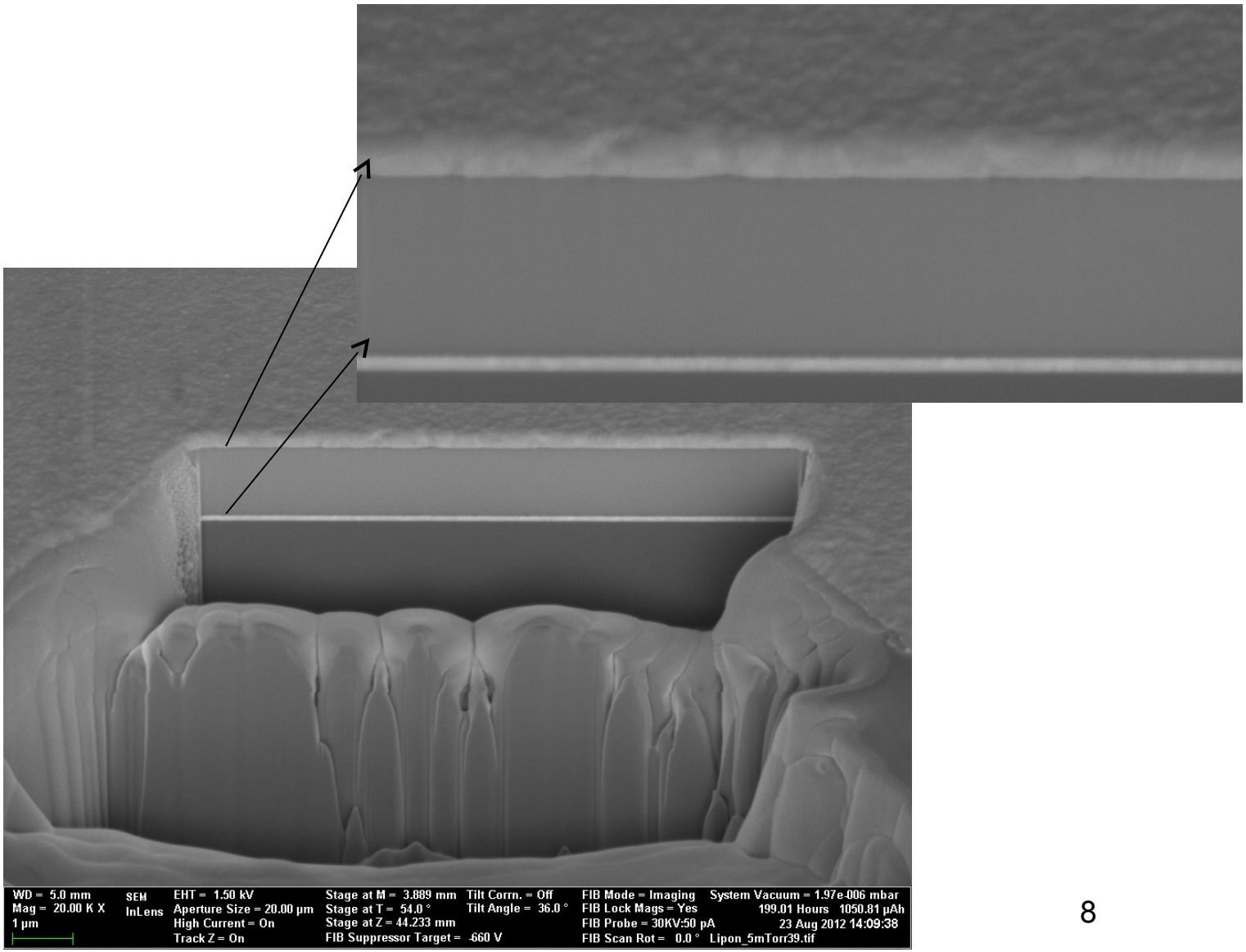




Example 2

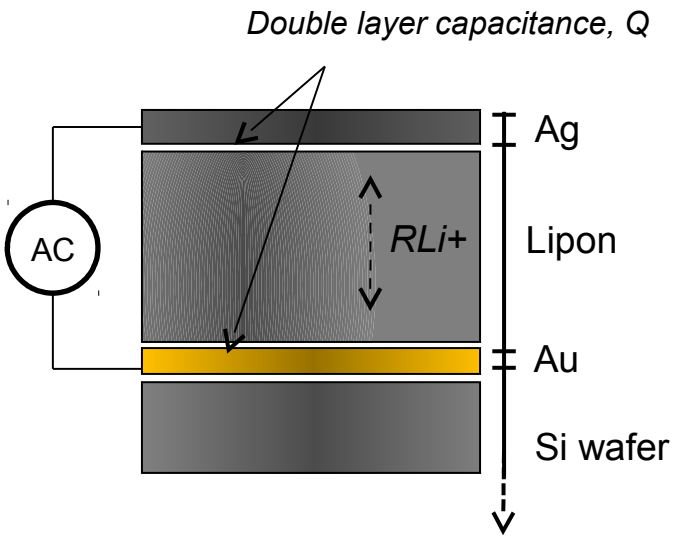
Conductivity measurements
of solid electrolytes

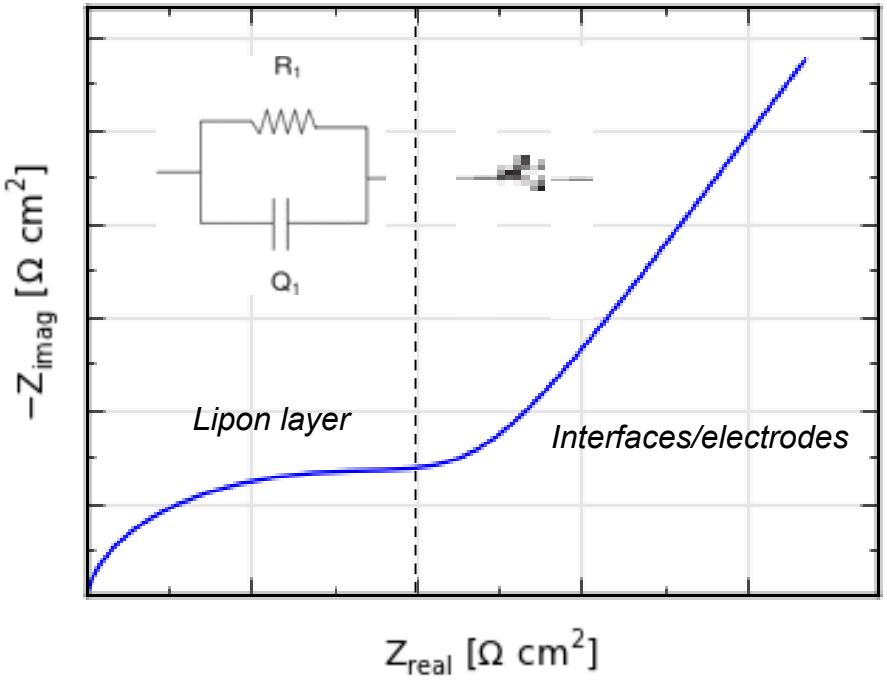
Thin film electrolyte (lipon)



Impedance Spectroscopy

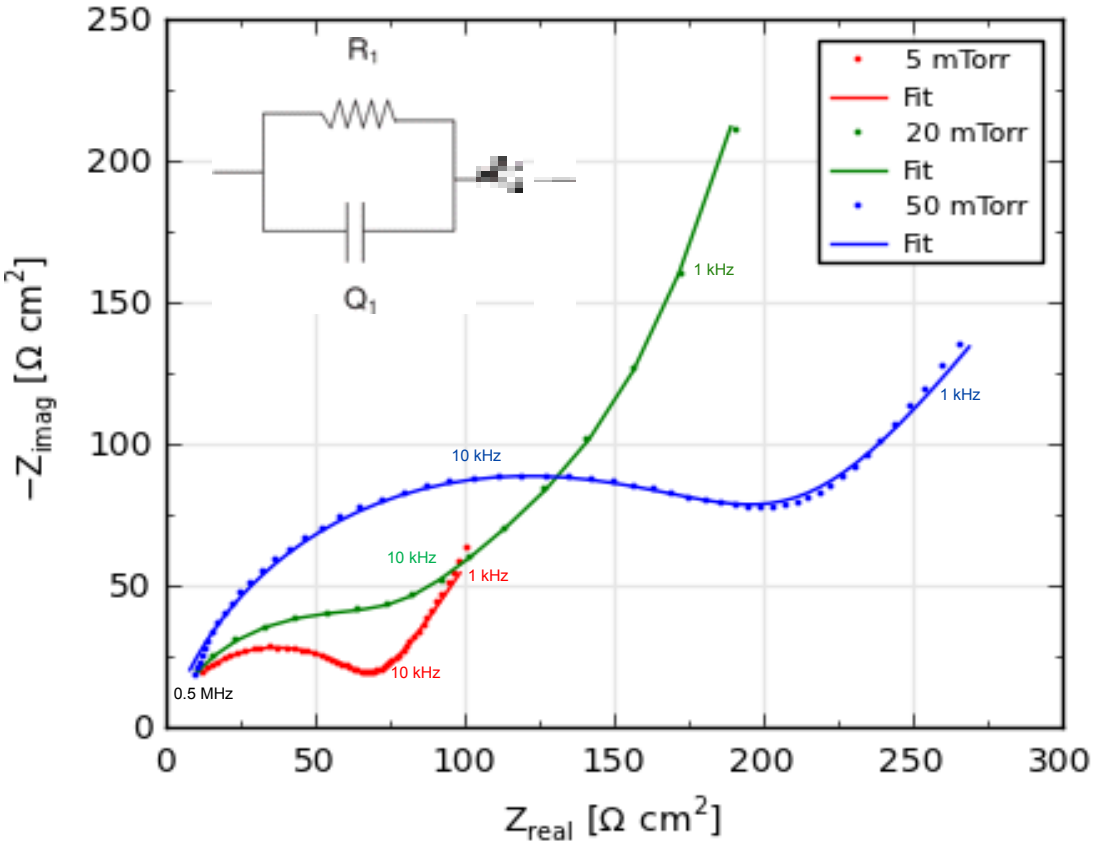
- Aim: To determine the electrical resistance of the thin film
- An equivalent circuit is fitted to the experimental data
- Cell: Ag/lipon/Au (blocking electrodes)





Impedance Spectroscopy

Results

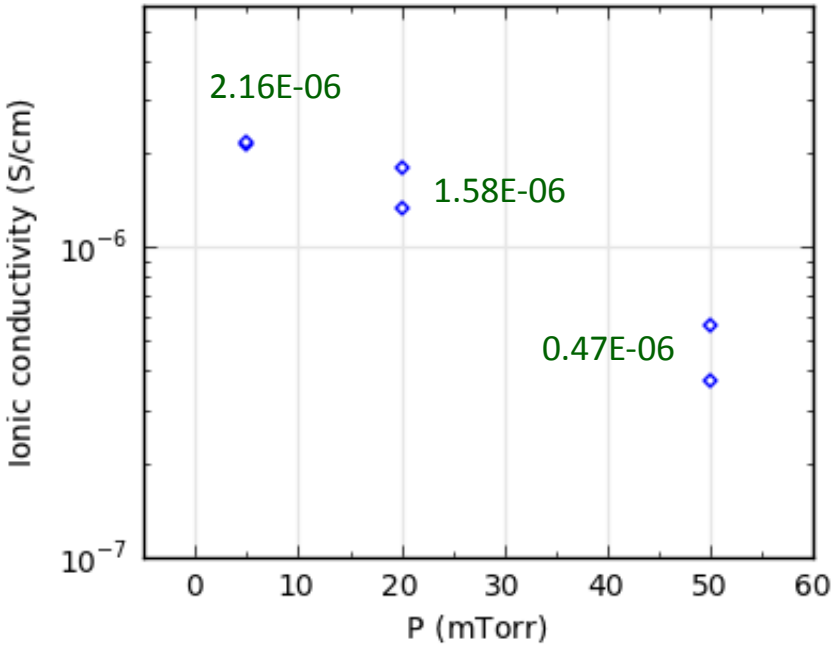


Setup. Conductive rubber is used as contact to the thin film surface

Conductivity

The ionic conductivity is based on the thickness of the sample (d), the area of the cell (A) and the resistance (R)

$$\sigma_{Li^+} = \frac{d}{A \cdot R}$$



Pressure (mTorr)	Conductivity (μS/cm)
5	**2.16a**
20	**1.58**
50	**0.47**

a: Identical to the max. conductivity found in literature at 2±1 μS/cm