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Investigating the Impact of Reference Electrodes with Mesh Geometry on Lithium-ion Batteries During Cycling

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Context

New European legislation on electric car batteries' durability:

State of health > 72% over 8y/160 000km^[1] (implementation in 2030)

Investigation of degradation mechanisms such as **Li plating**

Li plating mechanism:

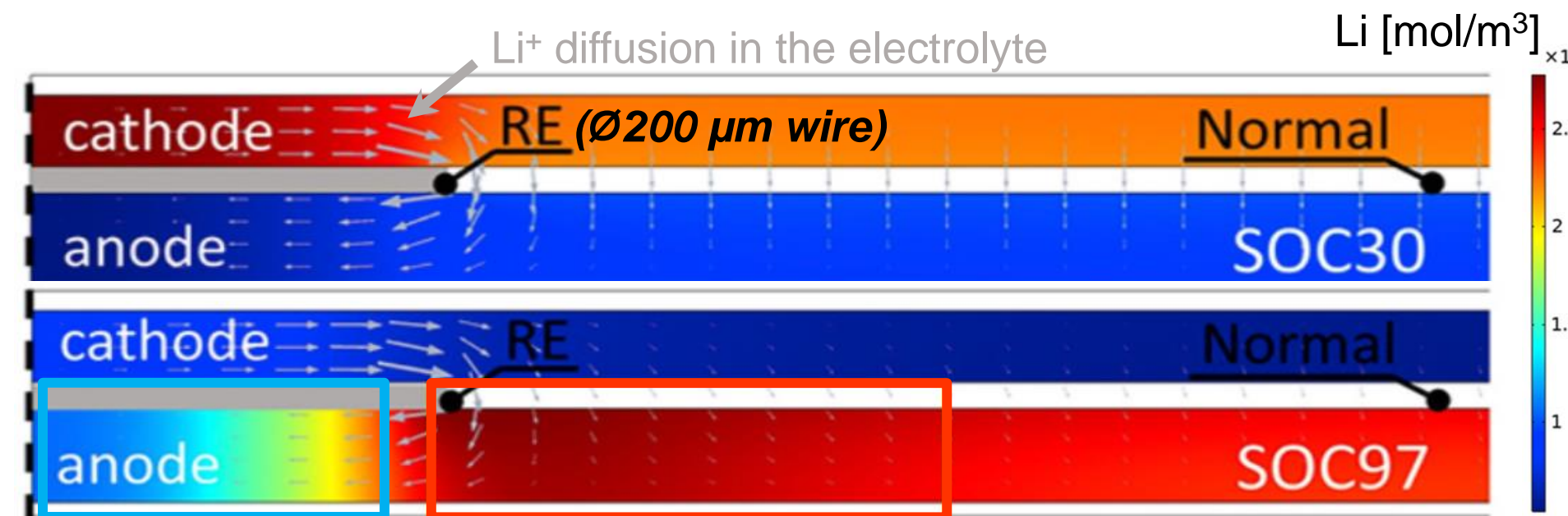
Irreversibly consumes Li⁺, reducing batterie state of health

Triggered locally when $E_{Graphite} < 0 \text{ V vs. Li}^+/\text{Li}^{[2]}$

How to detect Li plating?

Graphite potential monitoring with a **Reference Electrode (RE)**

The RE locally hinders the Li⁺ flow:



• **Excess of Li near the edge of the RE**

• **Deficit of Li under the RE**

Inhomogeneous lithiation

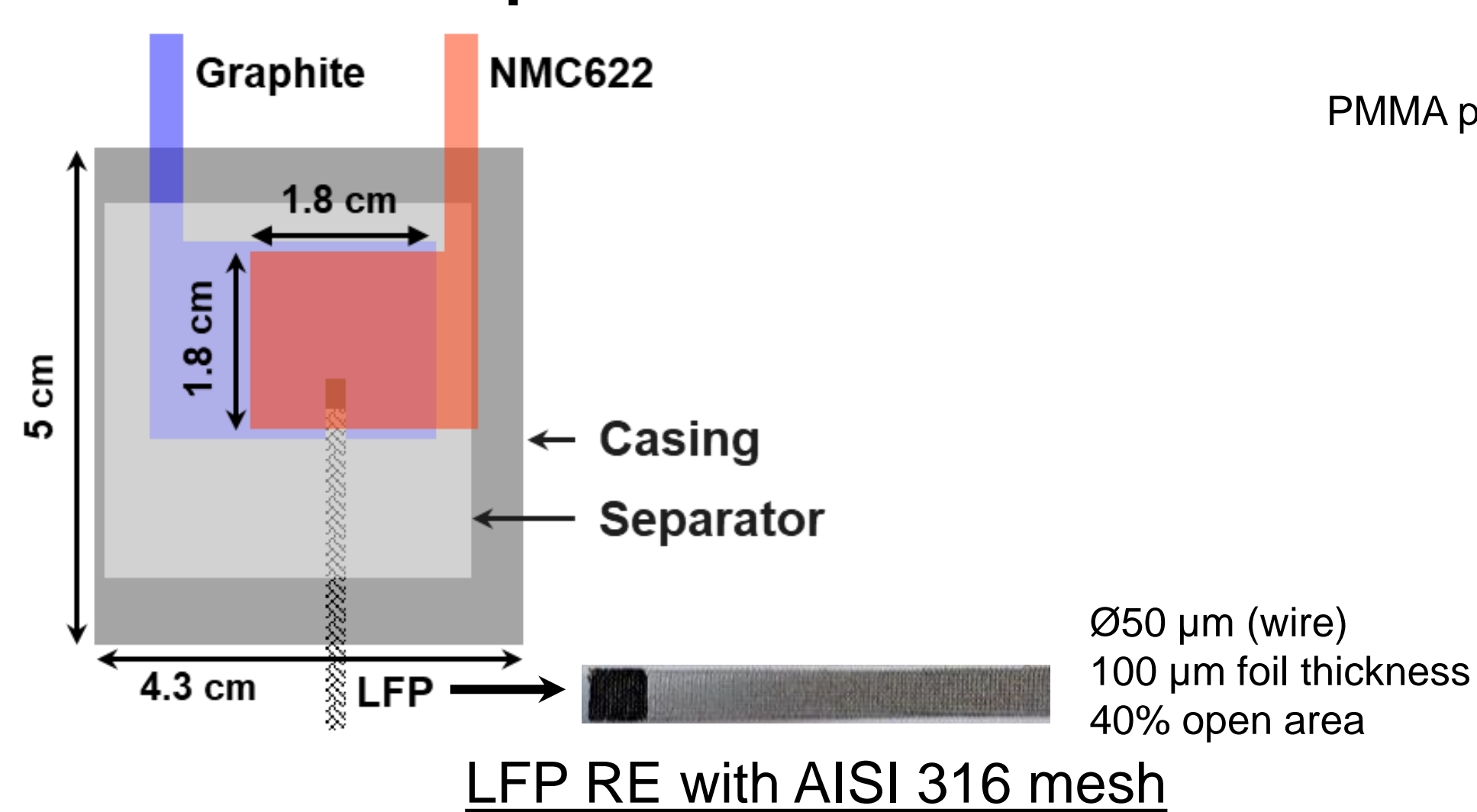
Different behaviors probed by the RE

Li distribution in electrodes near and far from the RE (modeling)^[adapted from 3]

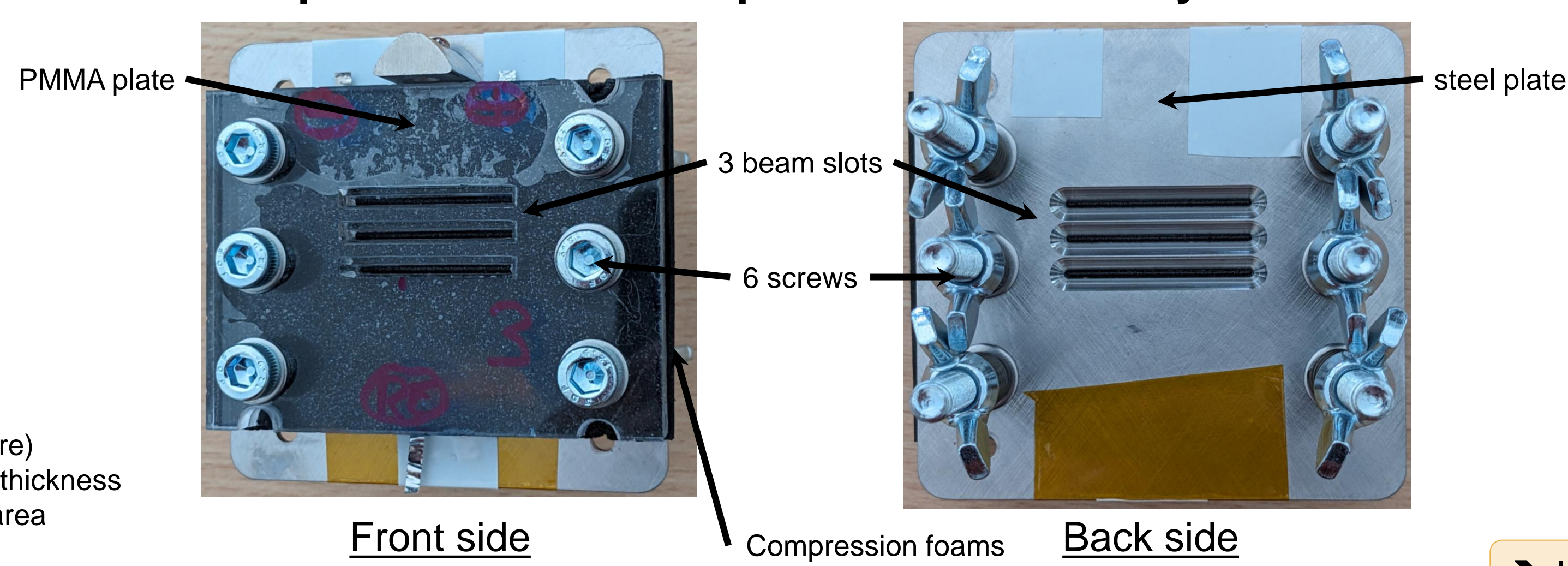
Objective: Quantify the impact of a RE with mesh geometry

Experimental set-up

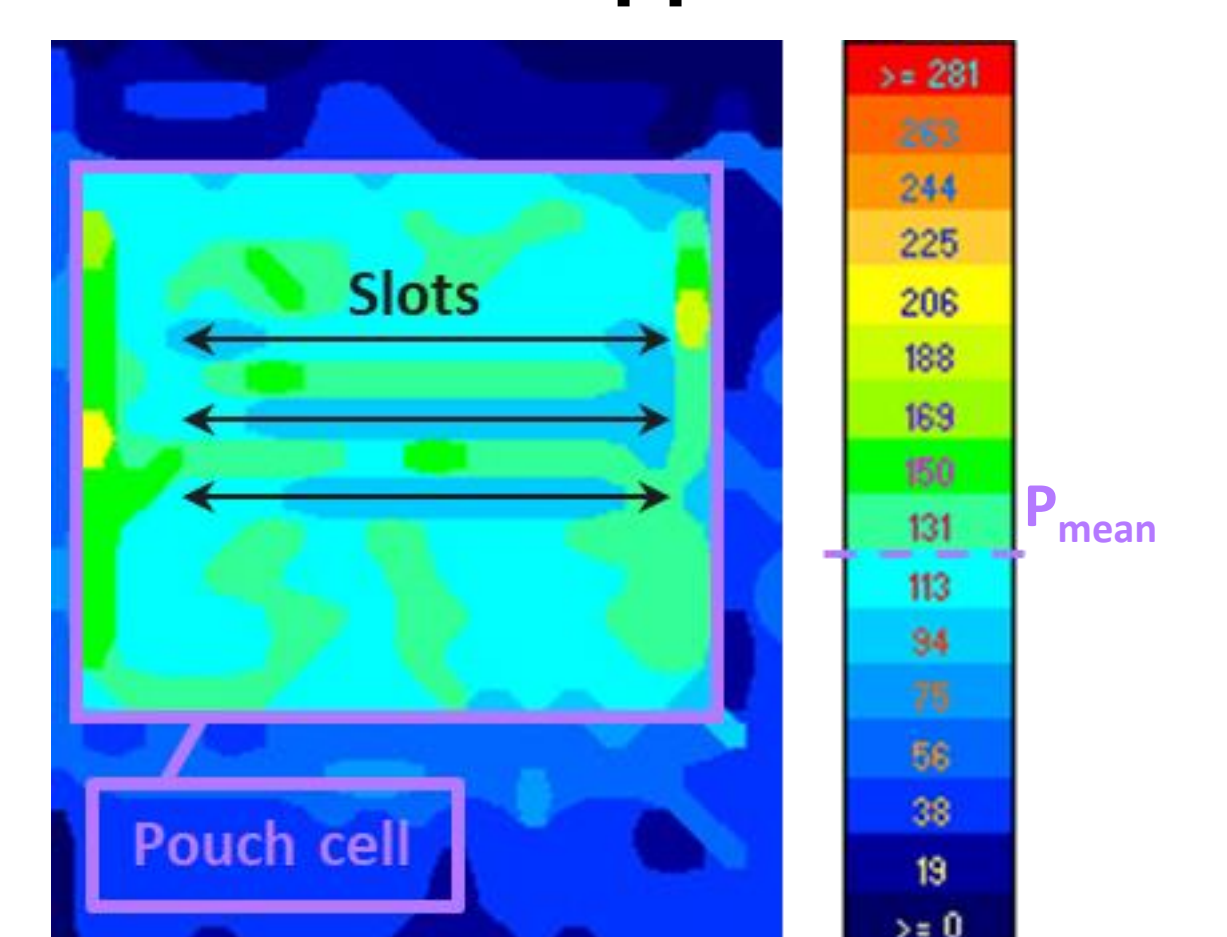
Three-electrode pouch cell:



Compression device for pouch cell with X-ray slots:

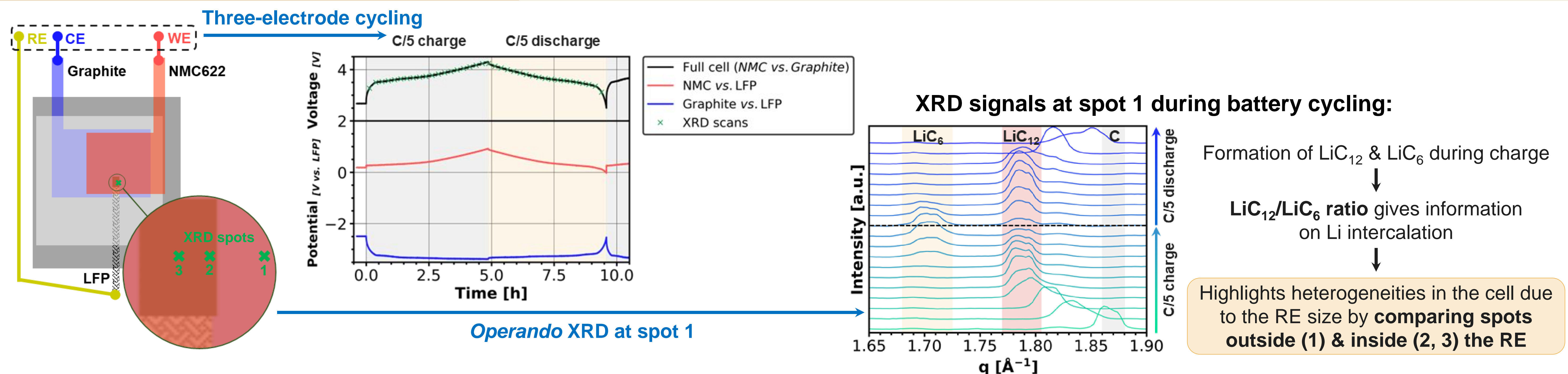


Pressure applied:

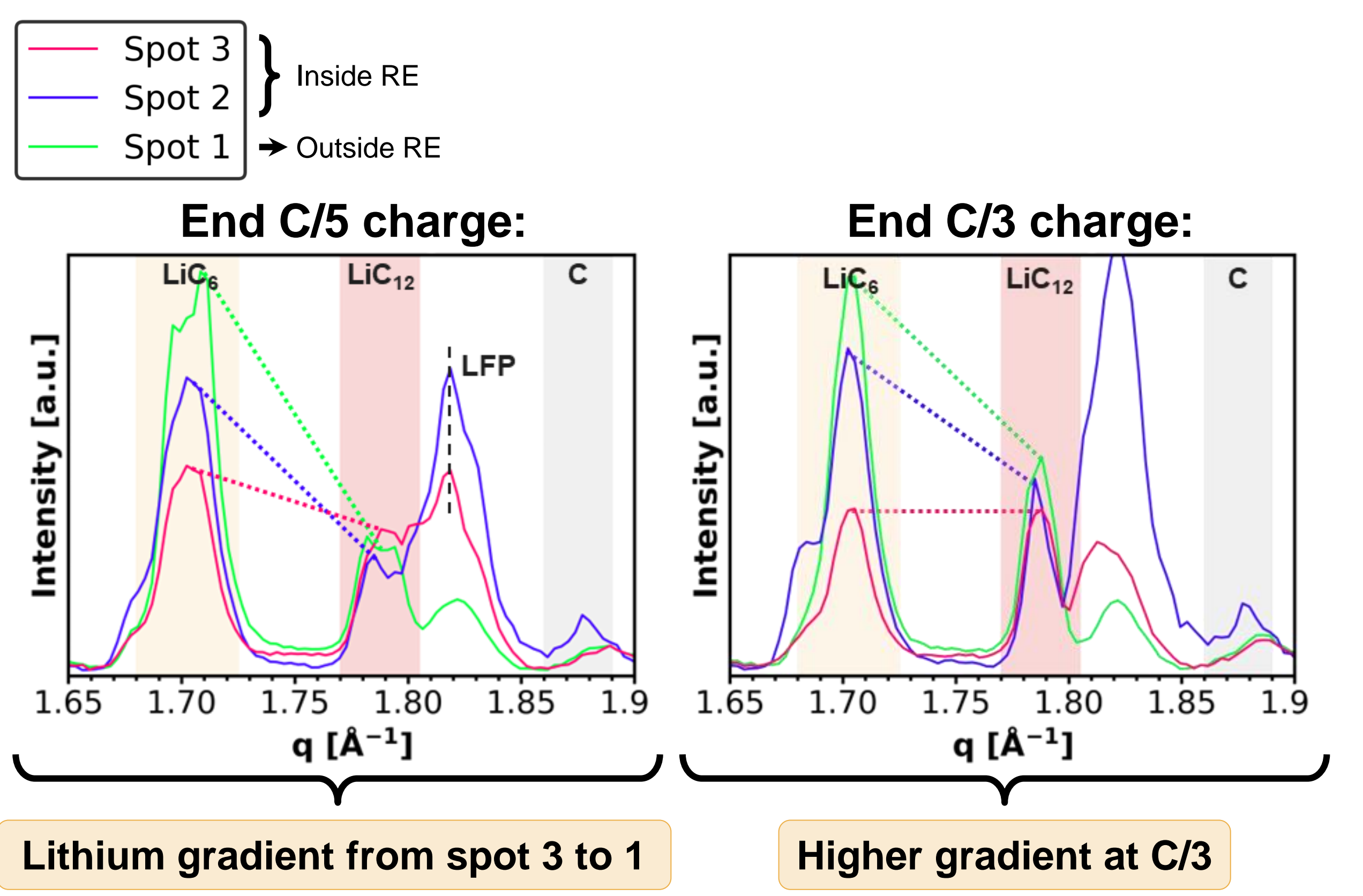


→ Homogeneous pressure applied in slots

X-ray diffraction at BM02 beamline



Tracking Li gradient



Perspectives

- Fit of LiC₁₂ & LiC₆ peaks for quantitative results
- Additional data at 1C, 2C and 3C to be investigated
- Correlation between LiC₁₂/LiC₆ ratio and RE measurement to study its accuracy
- Investigation of LFP peaks to follow the evolution of the RE chemical composition

References:

- [1] Euro 7, Regulation (EU) 2024/1257, Annex II (2024)
- [2] X. Lin et al., Prog. in Energy Combust. Sci., 87 (2021) 100953
- [3] Y. Li et al., J. Power Sources, 481 (2021) 228933