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Thèse ARC-4, 2016 – 2019
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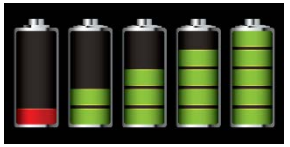
Development and *in situ* characterization of positive electrodes for Lithium/sulfur batteries

Equipe (CorrIS)

Context

Lithium/Sulfur batteries:

- Specific capacity of **1,673 mAh/g**
- Enery density of **~600Wh/kg**
- **Low-cost and abundant** active material



Challenges:

- Sulfur **dissolution** → mechanical stress → **reduced cycle life**
- **Complex electrochemistry**
- Still needs improvement for future commercialization

Aim:

- Better understanding of **complex electrochemical mechanisms**
- Use of novel ***in situ* and *operando* characterization methods**

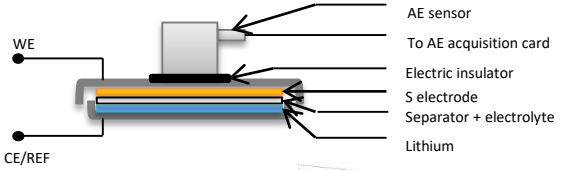
Method and tools

Characterization and comparison of different electrode formulations:

- Different electrode materials (binder, current collector)
- Different morphologies (2D, 3D…)

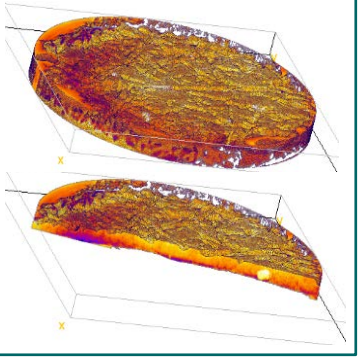
Acoustic Emission:

Detect **failure mechanisms** via acoustic events generated by the electrode materials upon cycling



X-ray tomography :

Direct visualization of the electrodes and their evolution upon cycling (synchrotron)



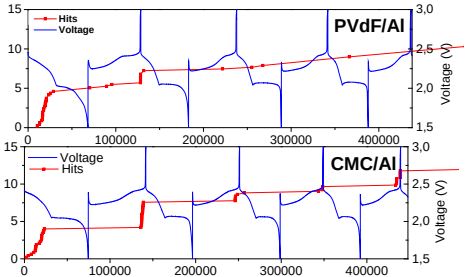
Other techniques :

- SEM, Optical microscope
- *In situ* XRD
- Dilatometry

Results

Acoustic Emission:

- Identification of different mechanical properties of different binder types



Comparison of the evolution of acoustic activity for 2 different binders on Al current collector

Electrode formulation:

- New combinations of binder / 3D current collector with good energy density
- **Poly-electrolyte binder (PEB)** promising and studied using Synchrotron Radiation

X-ray XRD and tomography:

- Evolution of PEB novel electrode during 1st and 10th cycle at **ESRF (Grenoble)**