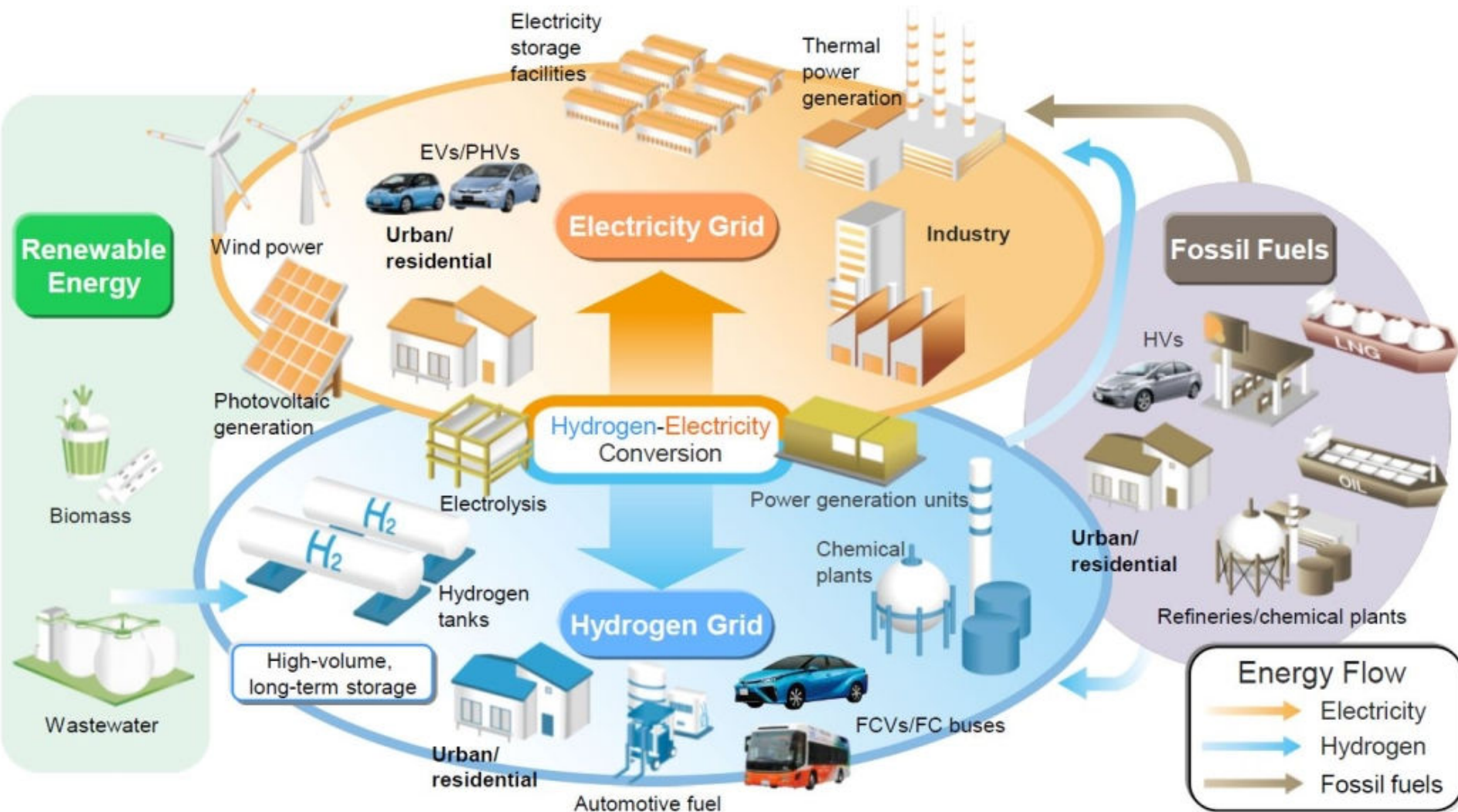


Use of the advanced X-ray sources to accelerate the development of batteries and fuel cells for mobile applications.

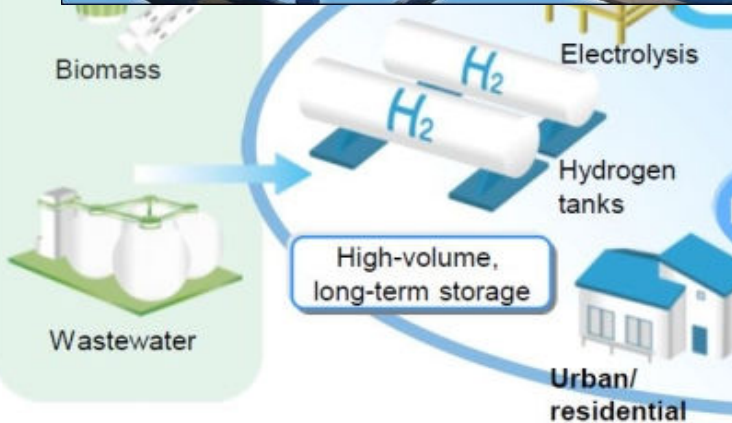
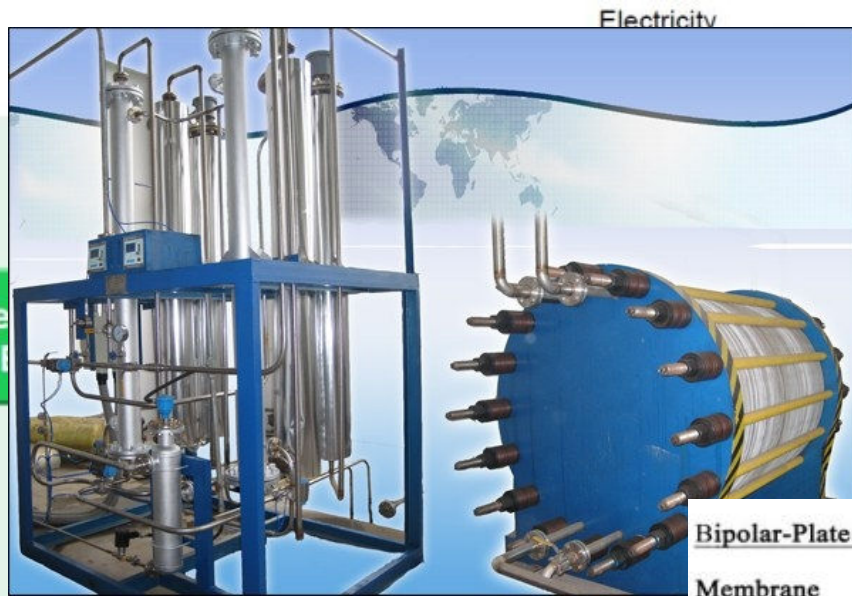
Jakub Drnec, Marco Di Michiel and Alexander Rack



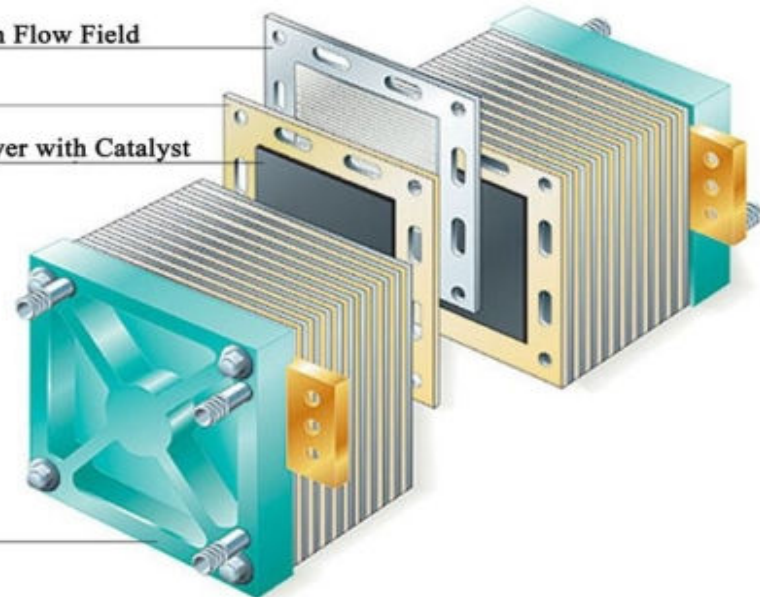
| The European Synchrotron



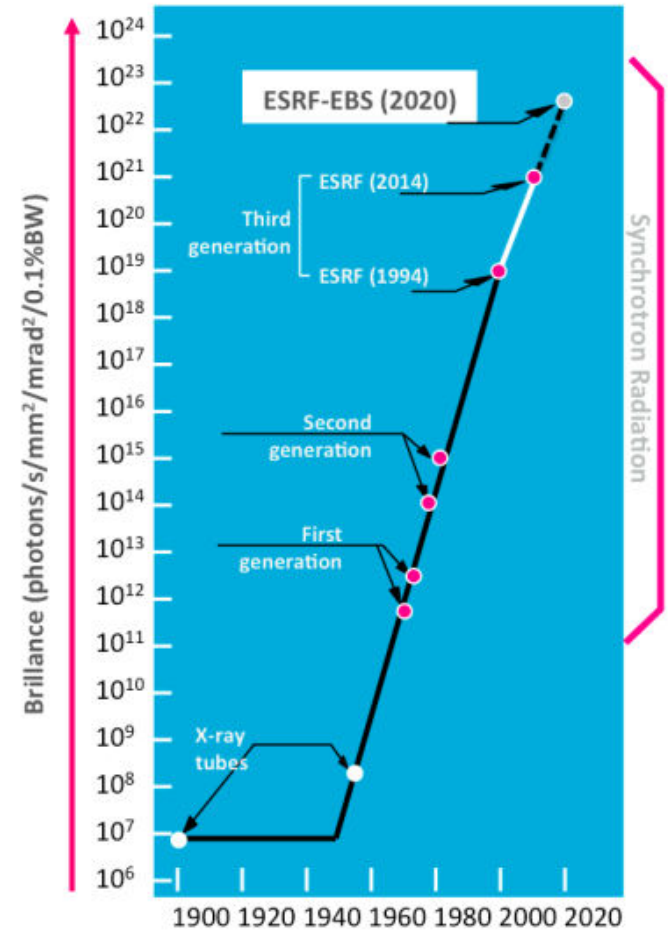
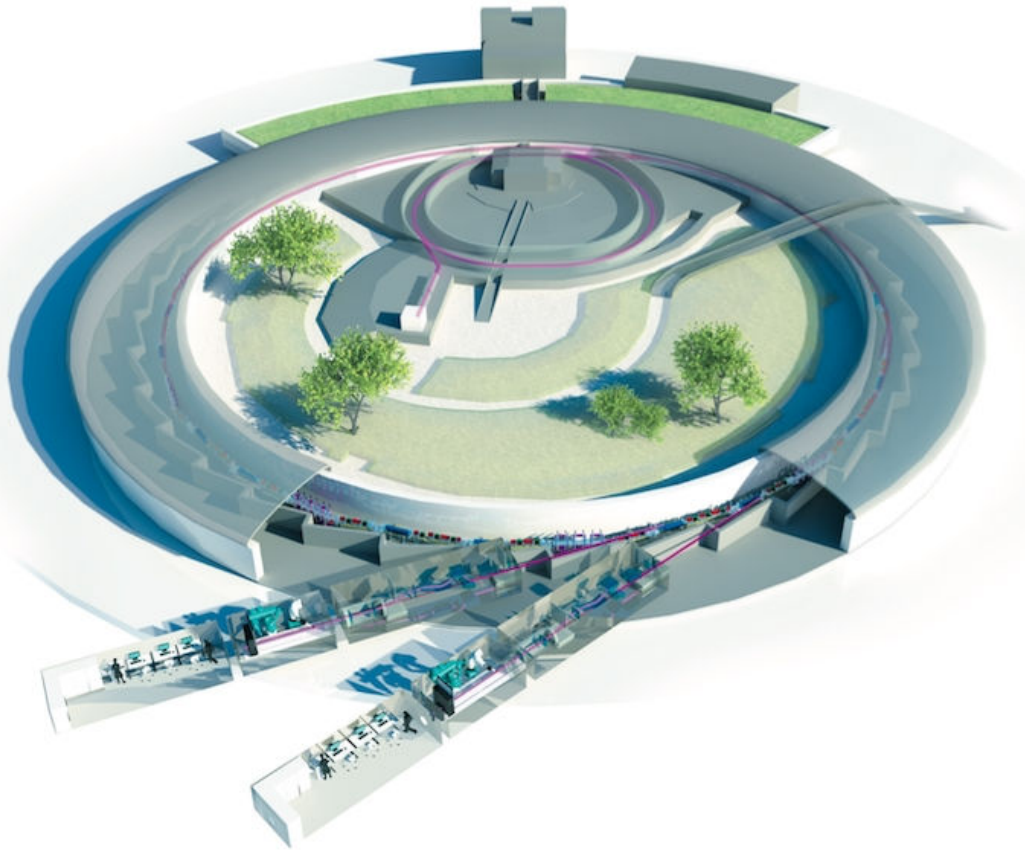
Sweet Future



Bipolar-Plate with Flow Field
Membrane
Gas Diffusion Layer with Catalyst



ESRF – Extremely Bright X-ray Source



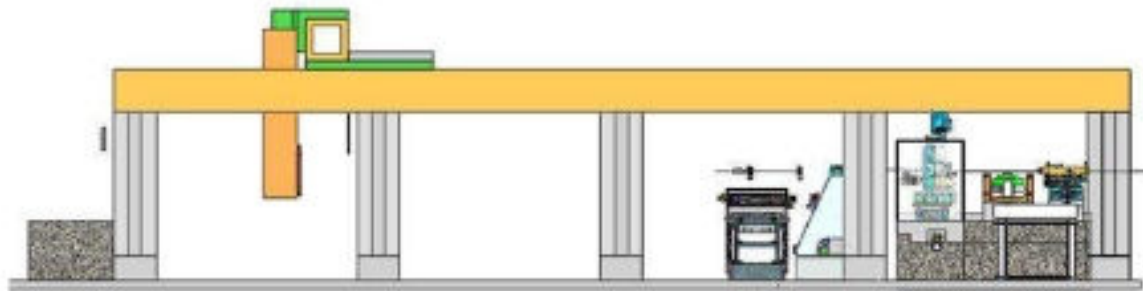
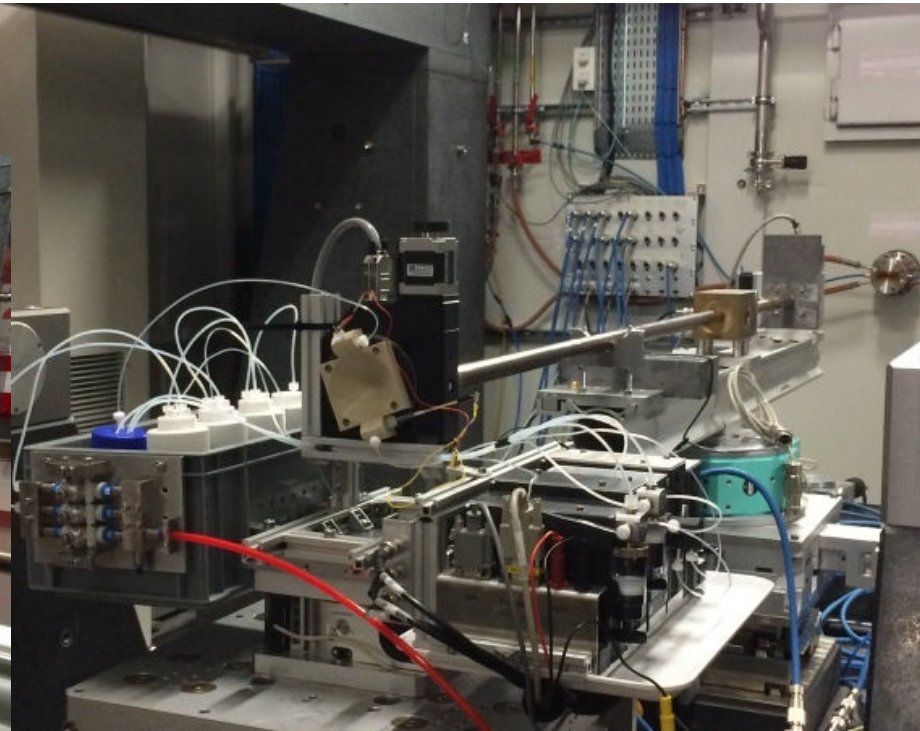
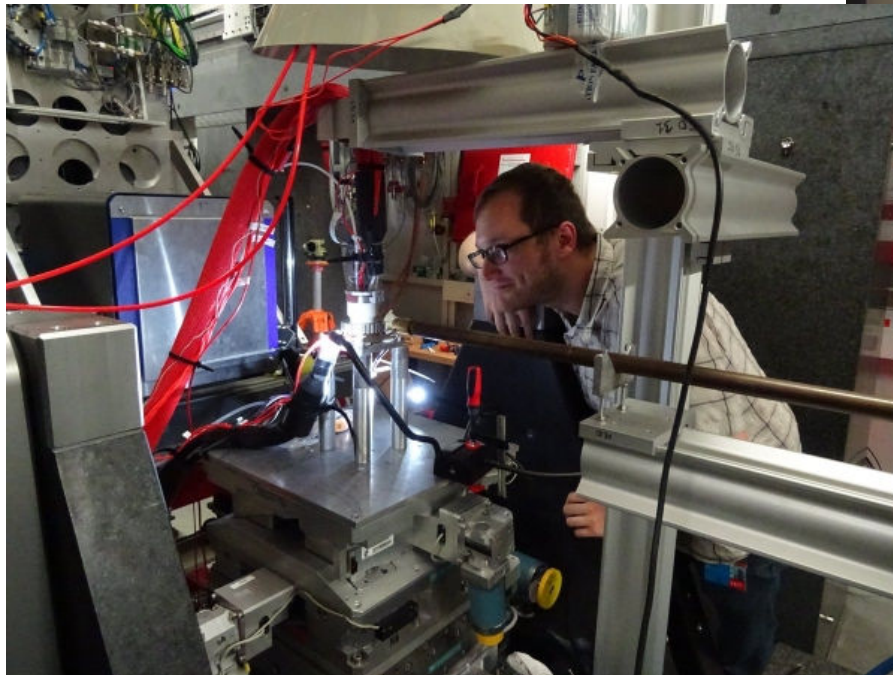
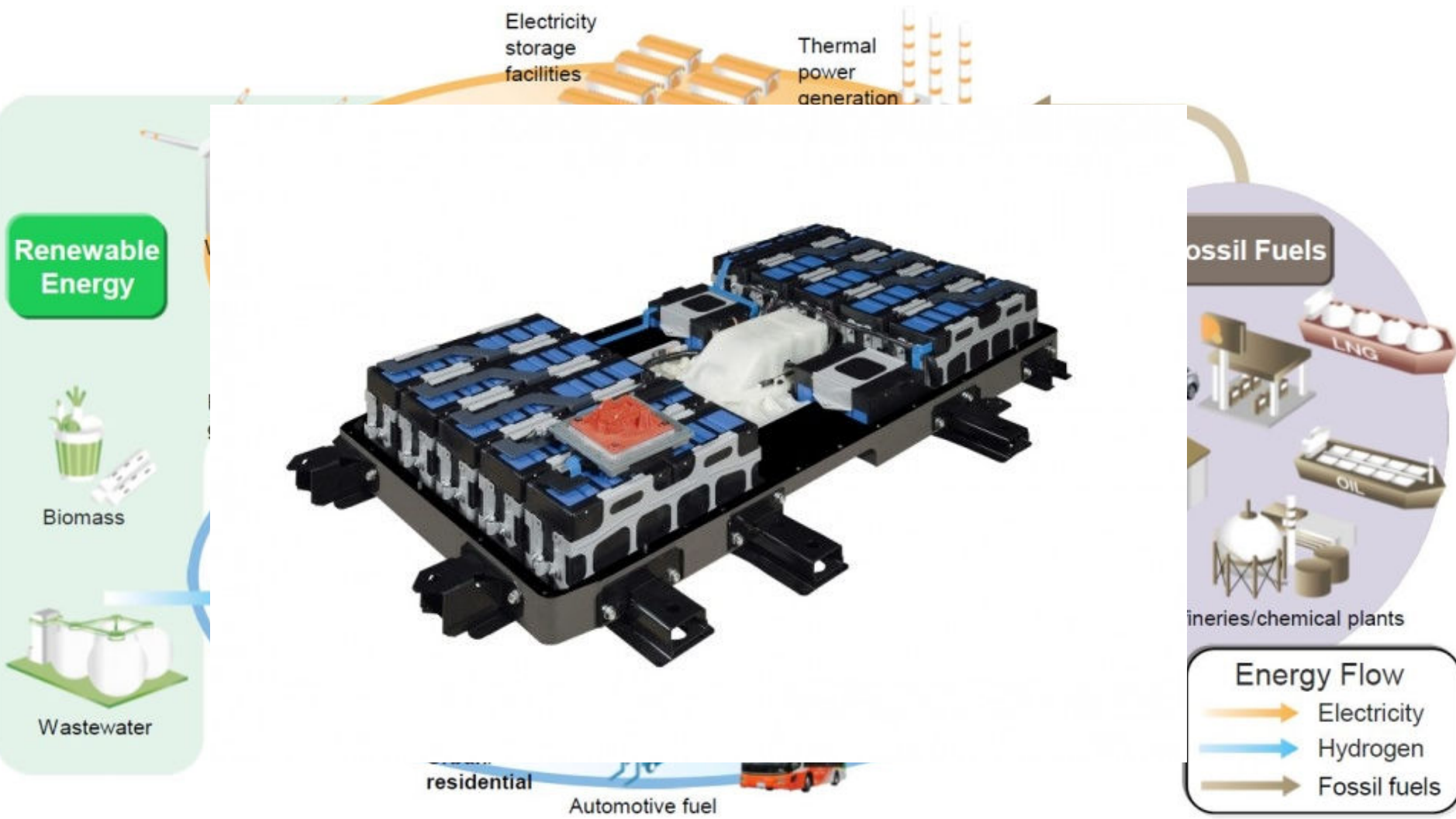


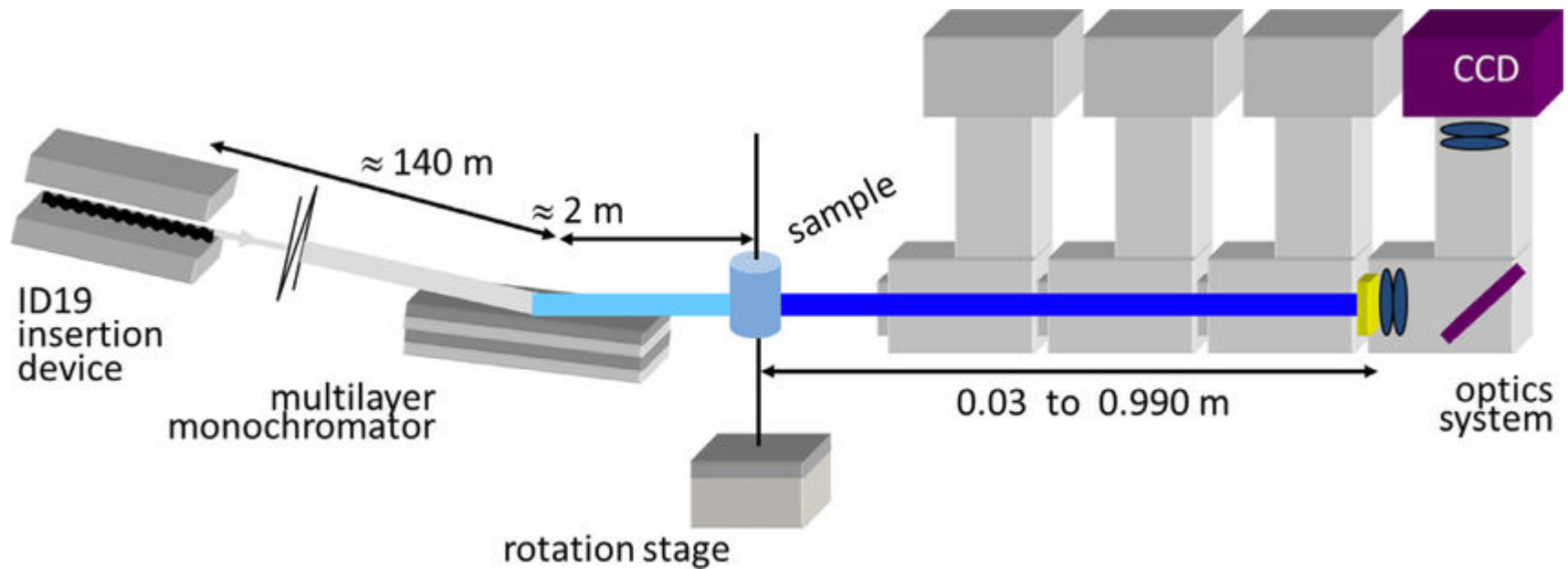
Figure 5. Side view of the experimental hutches



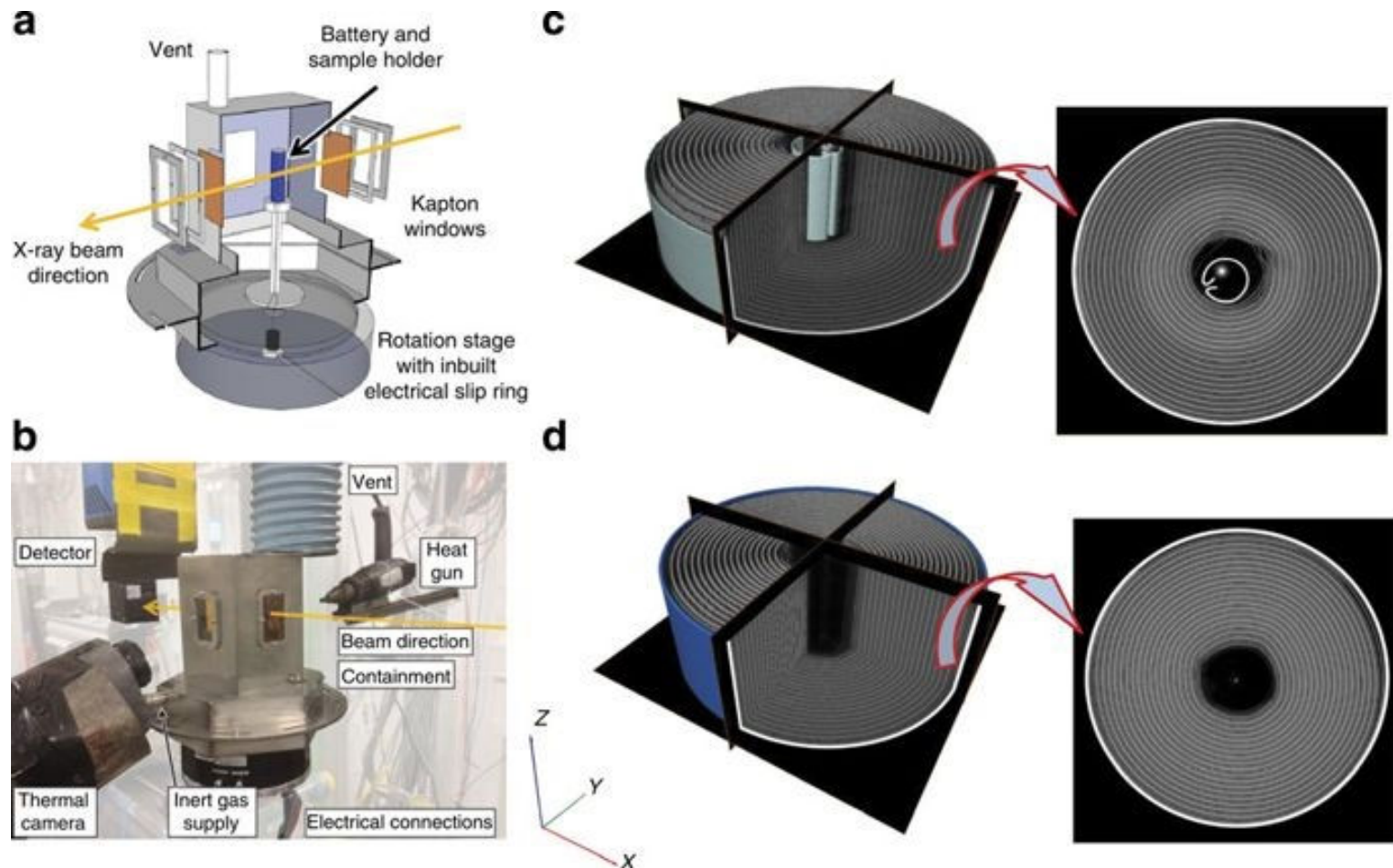
Sweet Future



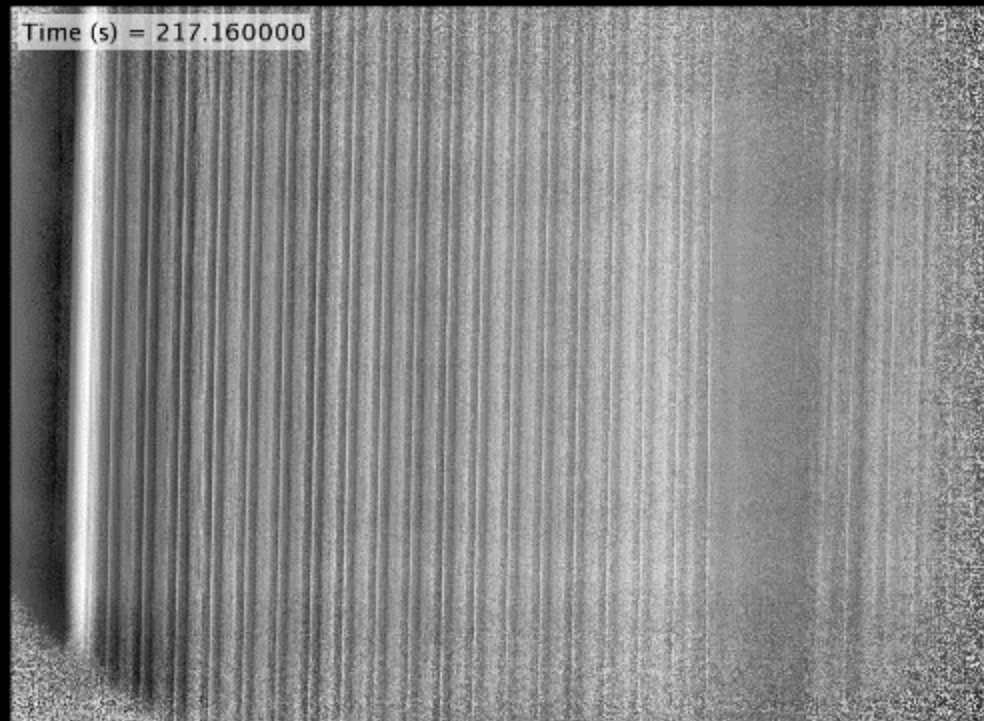
Ultra fast X-ray imaging and Computed Tomography



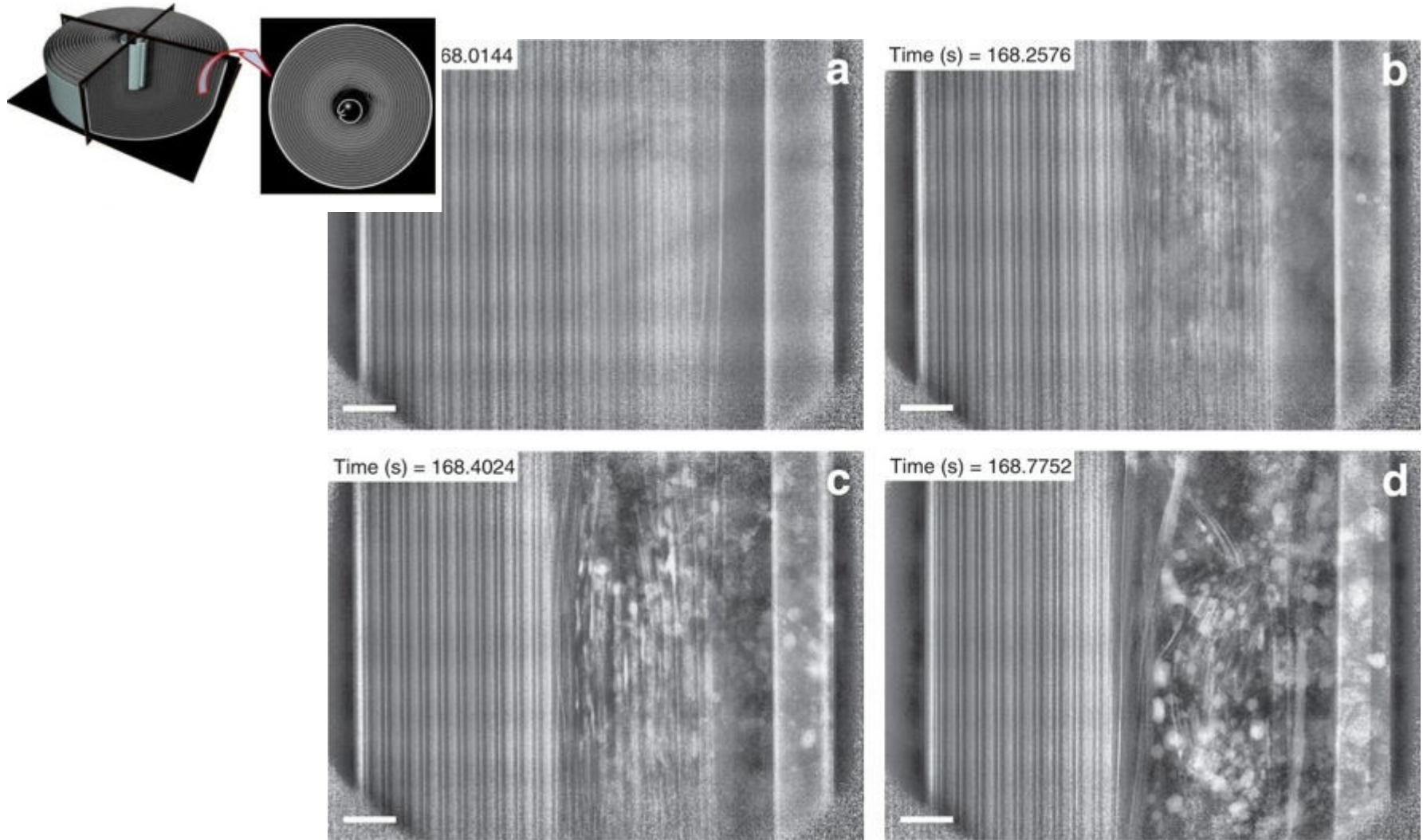
Exploding batteries – thermal runaway



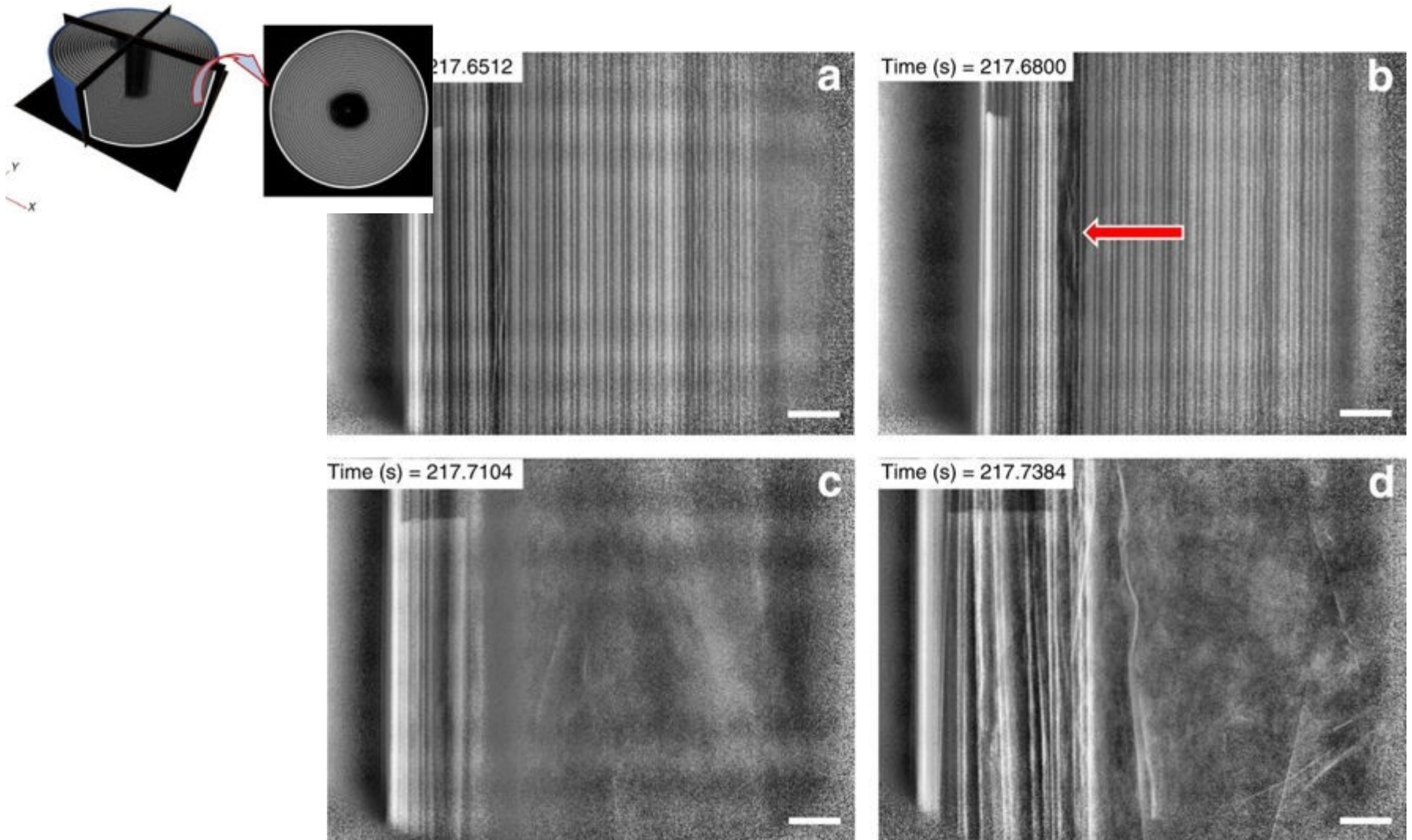
Exploding batteries – thermal runaway



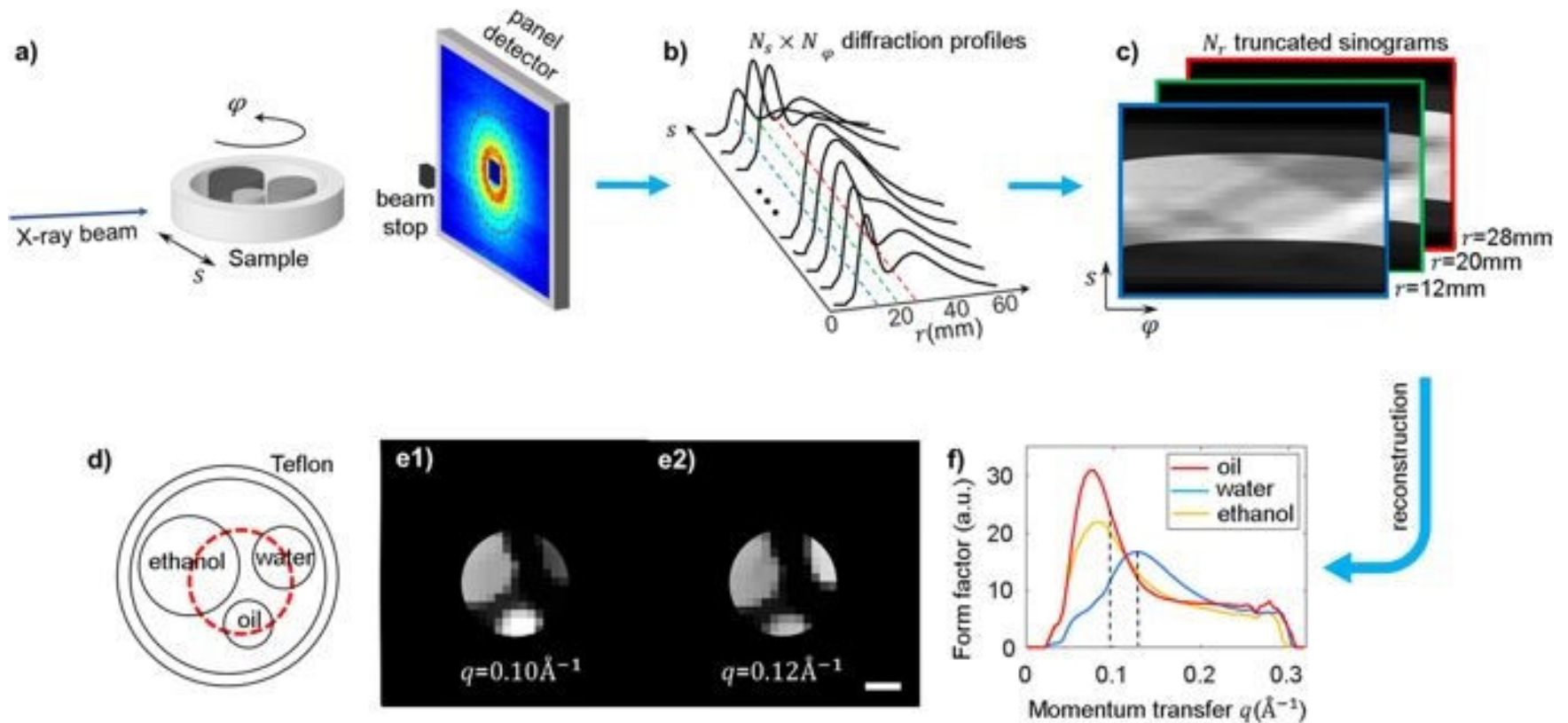
Exploding batteries – thermal runaway



Exploding batteries – thermal runaway

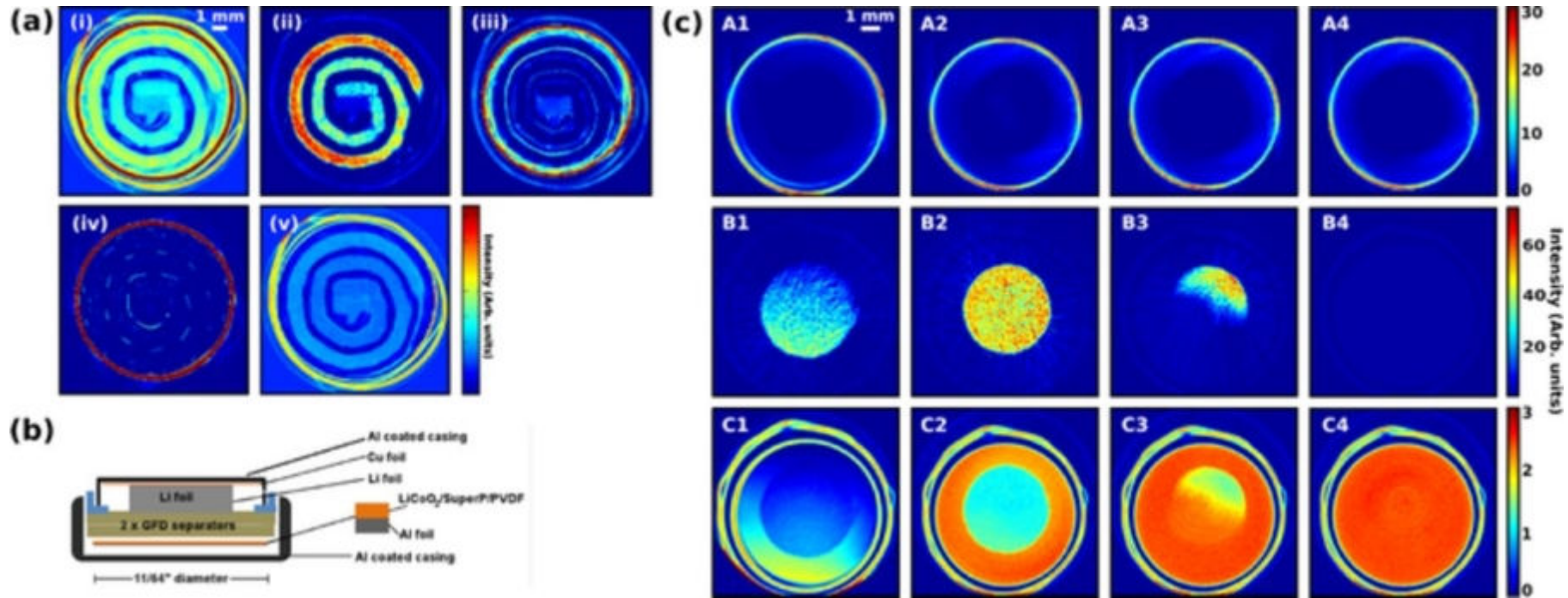


XRD – Computed Tomography



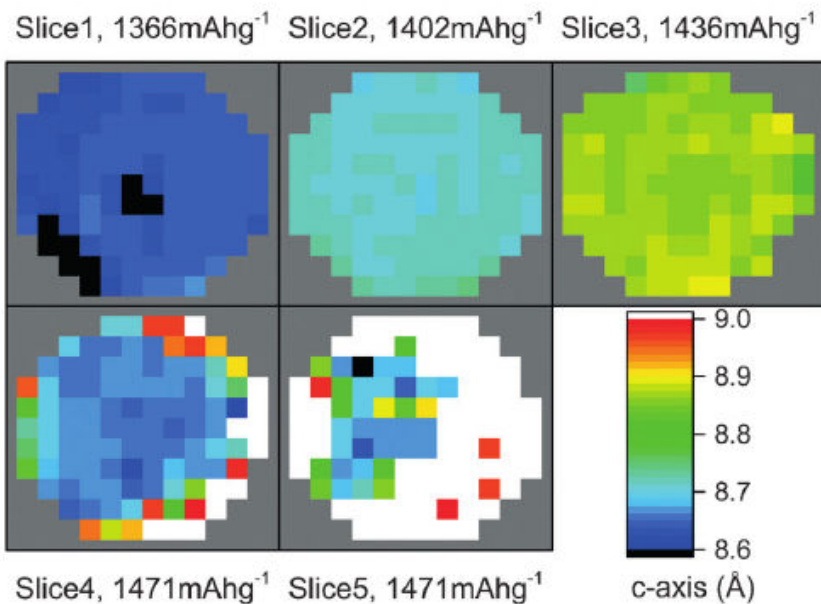
Z. Zhu et al, Scientific Reports 8(2018), 522

NiMH battery imaging



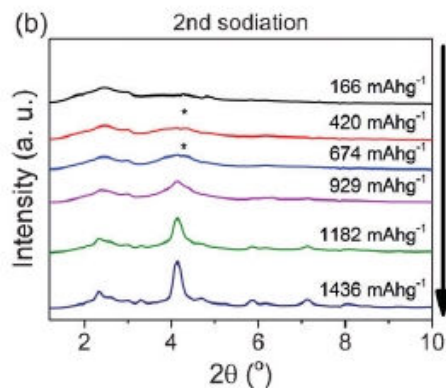
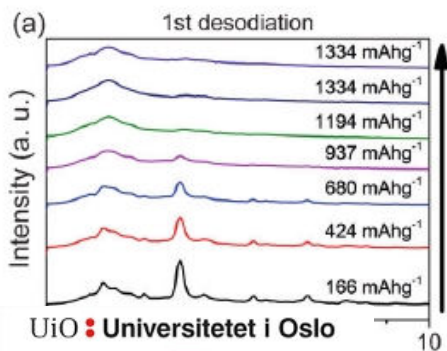
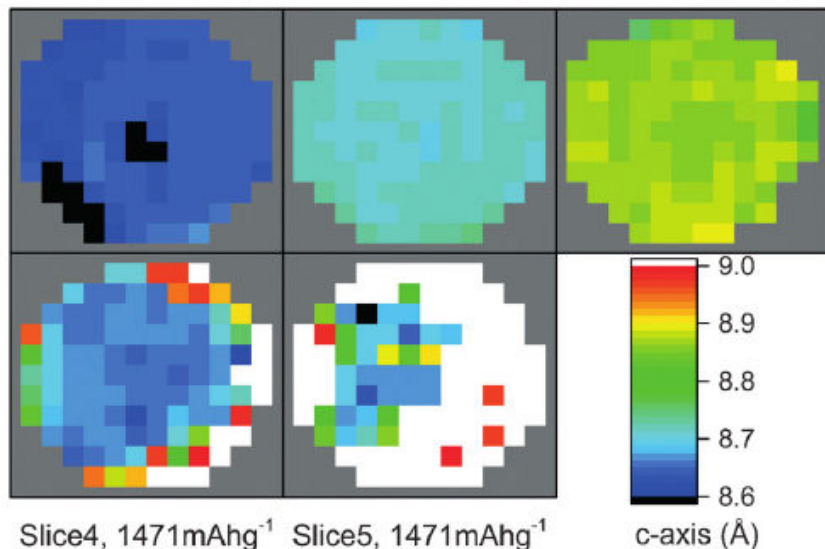
Kirsten M. Ø. Jensen et al. J. Electrochem. Soc. 162(2015);A1310-A1314

Sodiation and desodiation of phosphate battery cathode



Sodiation and desodiation of phosphate battery cathode

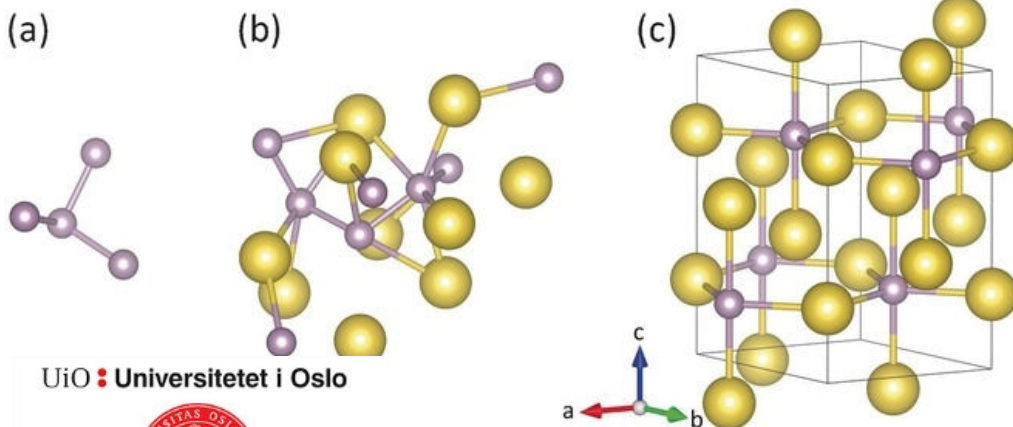
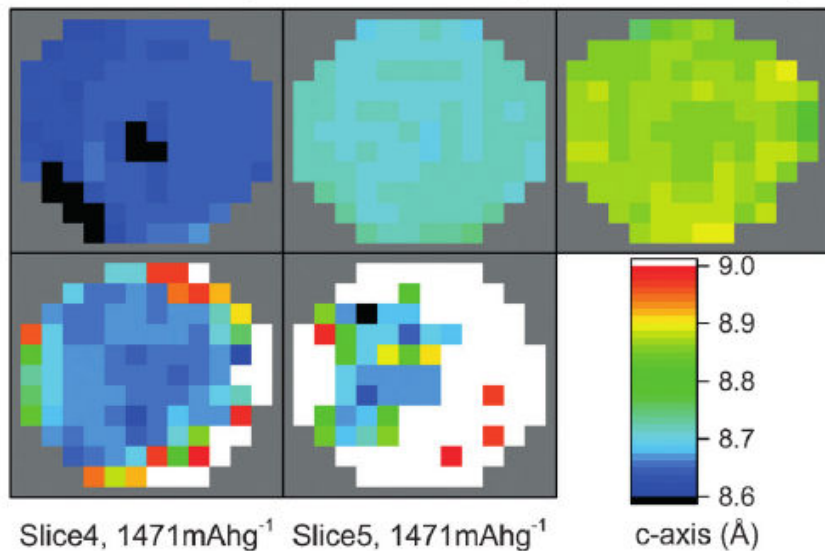
Slice1, 1366mAhg⁻¹ Slice2, 1402mAhg⁻¹ Slice3, 1436mAhg⁻¹



Sottmann et al., Angew. Int. Ed., 2017

Sodiation and desodiation of phosphate battery cathode

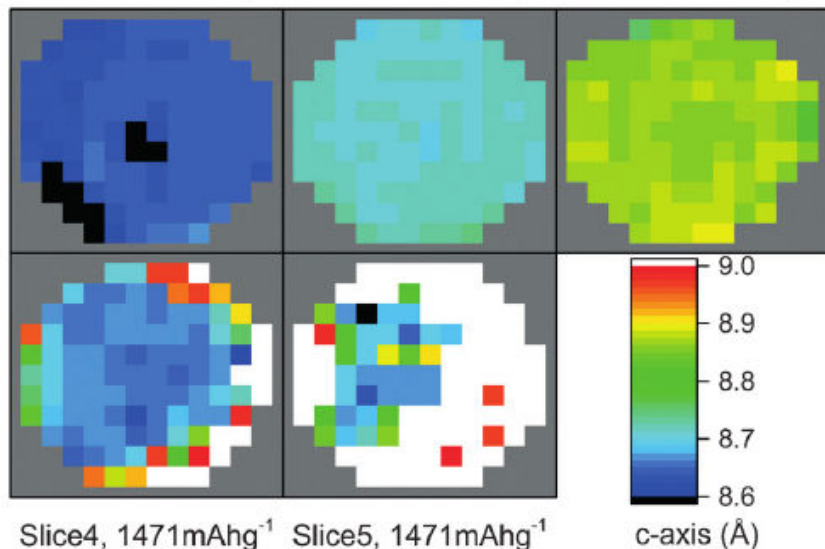
Slice1, 1366mAhg⁻¹ Slice2, 1402mAhg⁻¹ Slice3, 1436mAhg⁻¹



Sottmann et al., Angew. Int. Ed., 2017

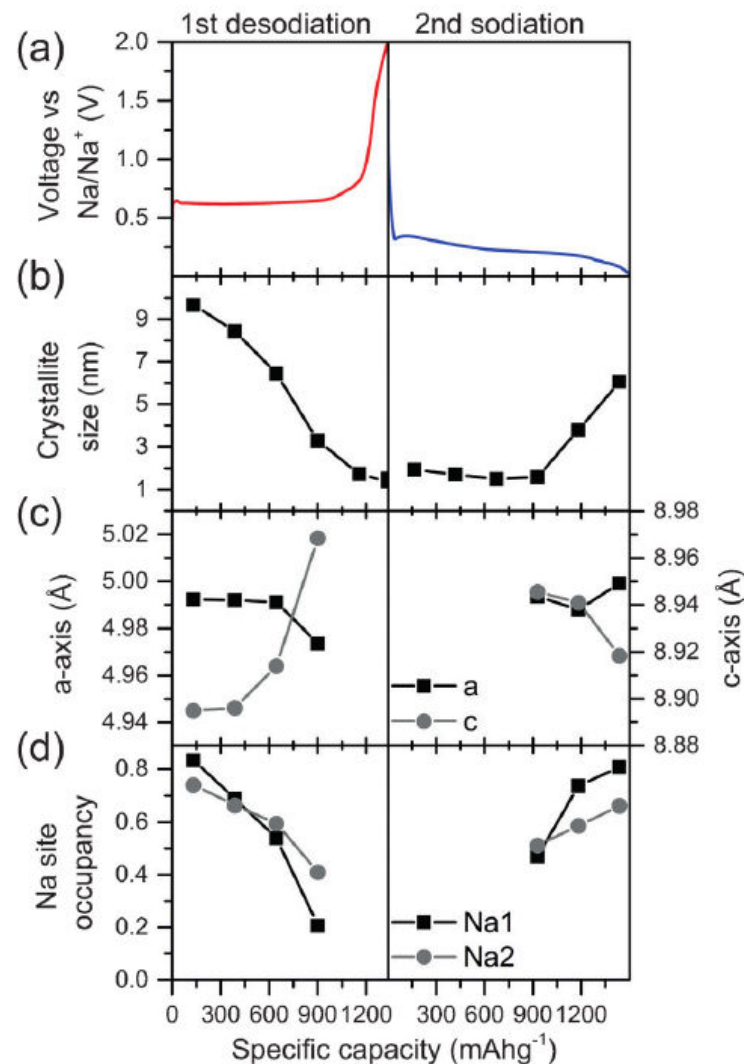
Sodiation and desodiation of phosphate battery cathode

Slice1, 1366mAhg⁻¹ Slice2, 1402mAhg⁻¹ Slice3, 1436mAhg⁻¹



Slice4, 1471mAhg⁻¹ Slice5, 1471mAhg⁻¹

c-axis (Å)

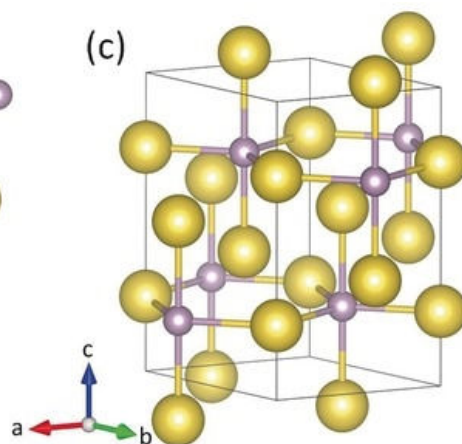


(a)

(b)

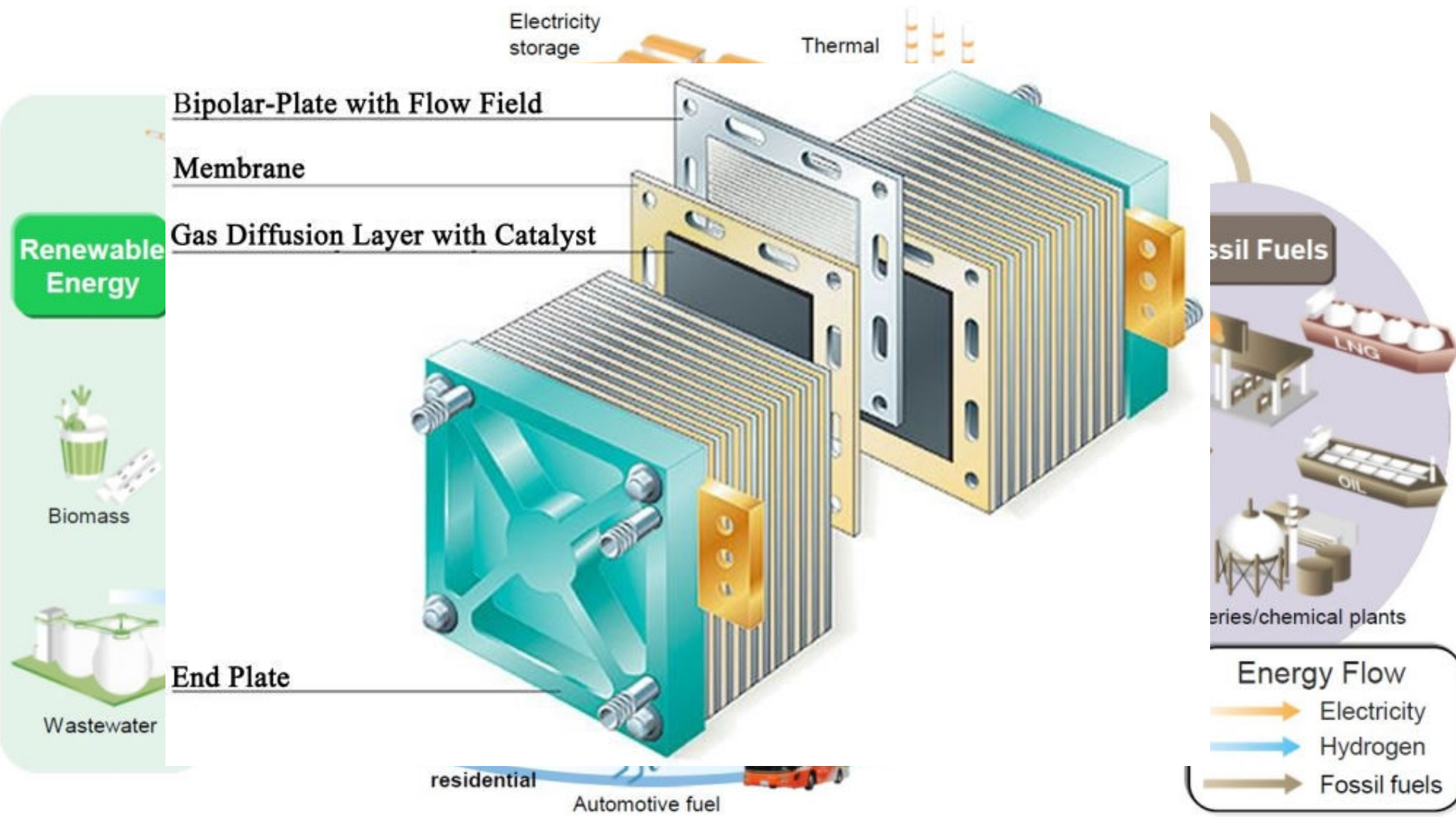
(c)

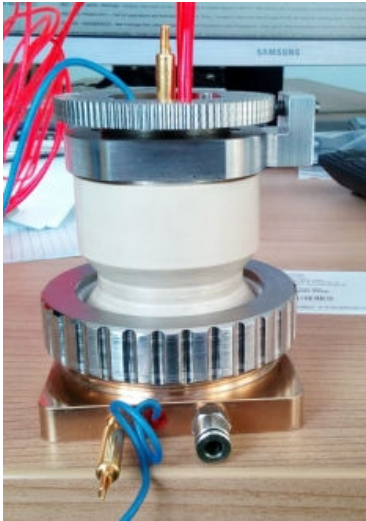
UiO : Universitetet i Oslo



Sottmann et al., Angew. Int. Ed., 2017

Sweet Future





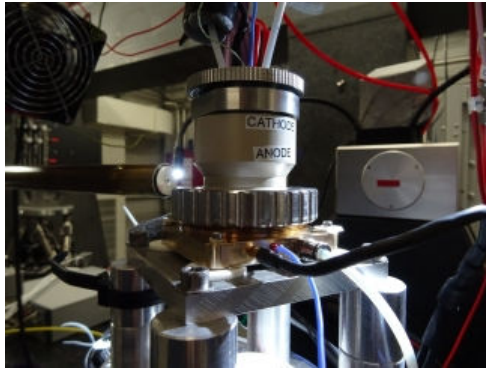
Baltic fuel cells

- Standard 5 cm² flowfield with parallel channels
- High current densities (3 A/cm²)
- Independent heating of anode and cathode
- 360° unobstructed field of view
- PEEK housing



LeanCat

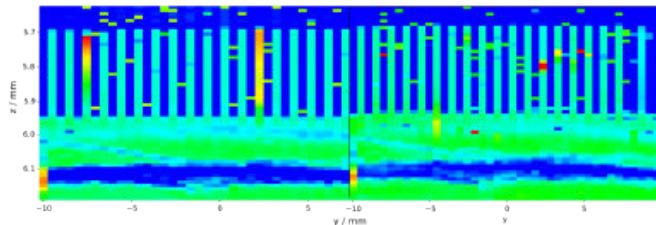
Fuel Cell Studies



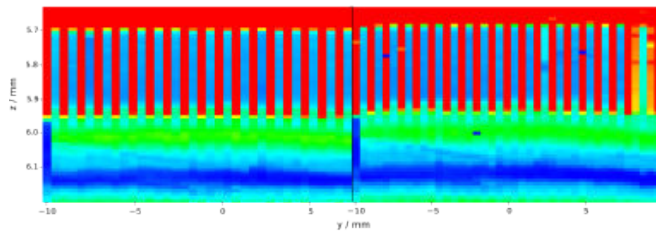
30% RH

Water

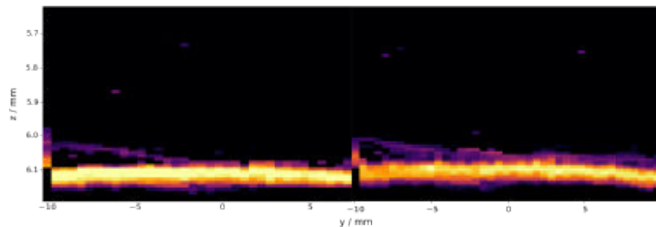
100% RH



Carbon

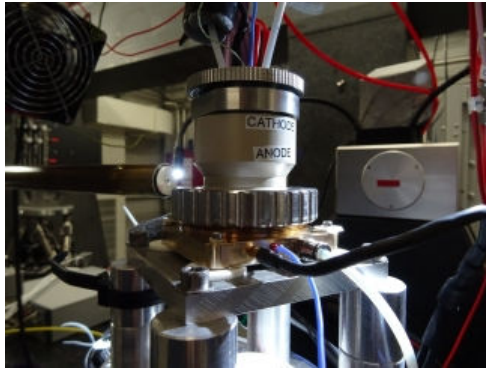


Platinum

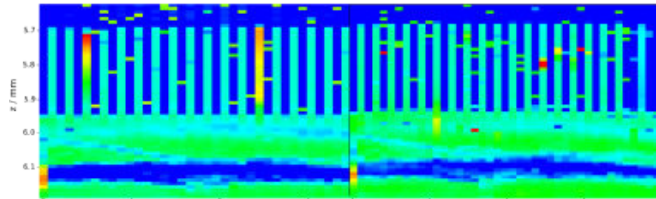


J. Drnec et al., in preparation

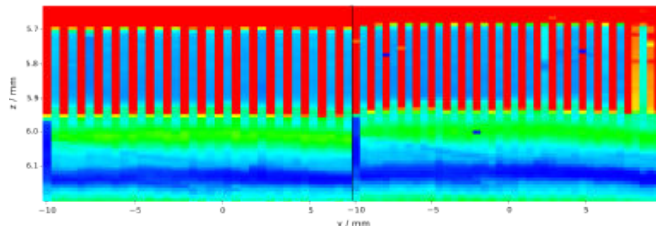
Fuel Cell Studies



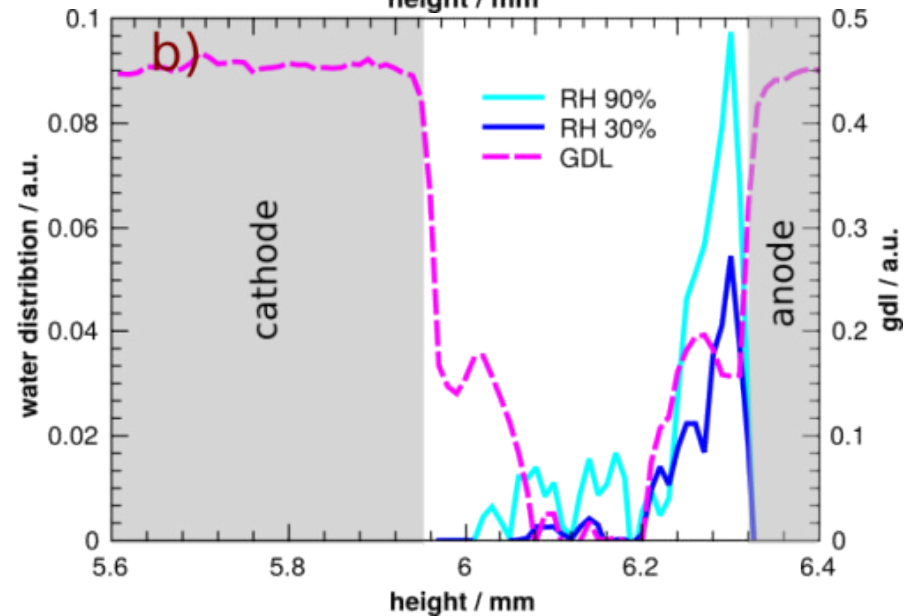
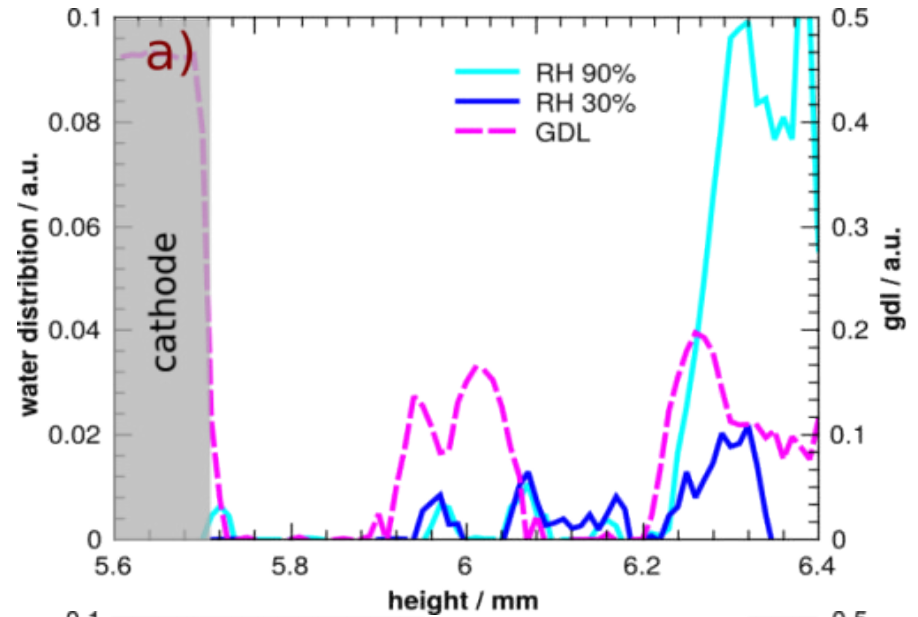
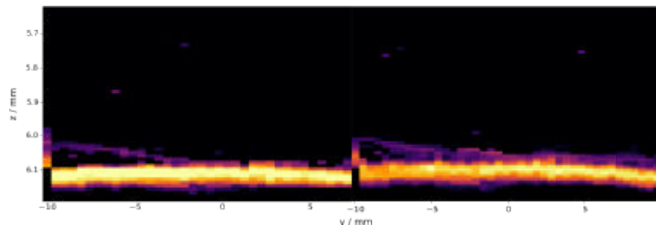
30% RH Water 100% RH



Carbon

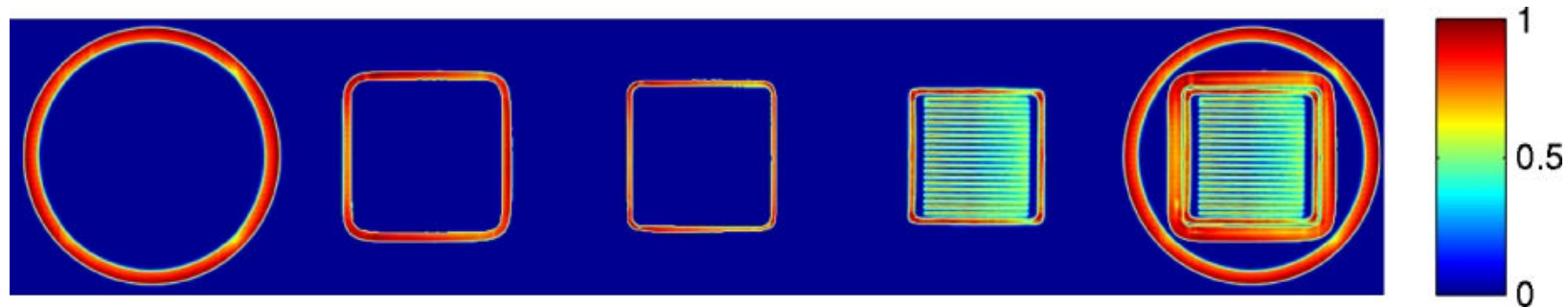


Platinum



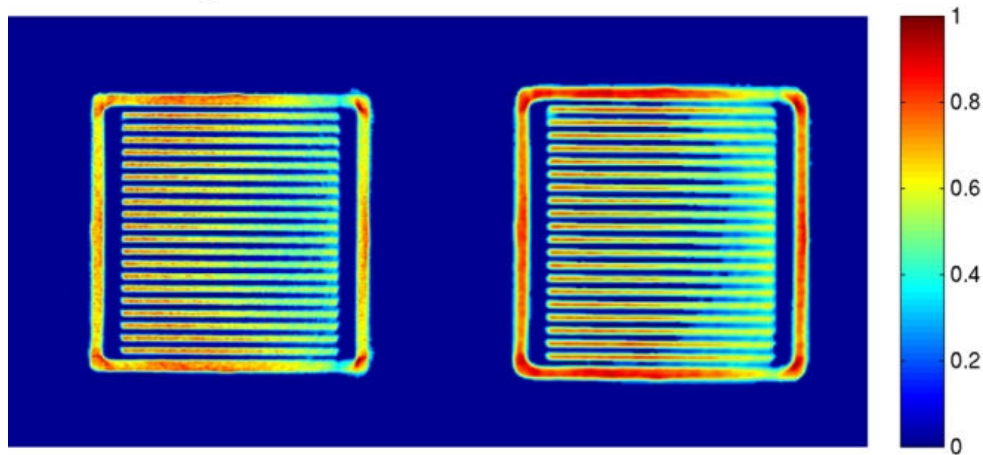
J. Drnec et al., in preparation

XRD-CT test reconstruction

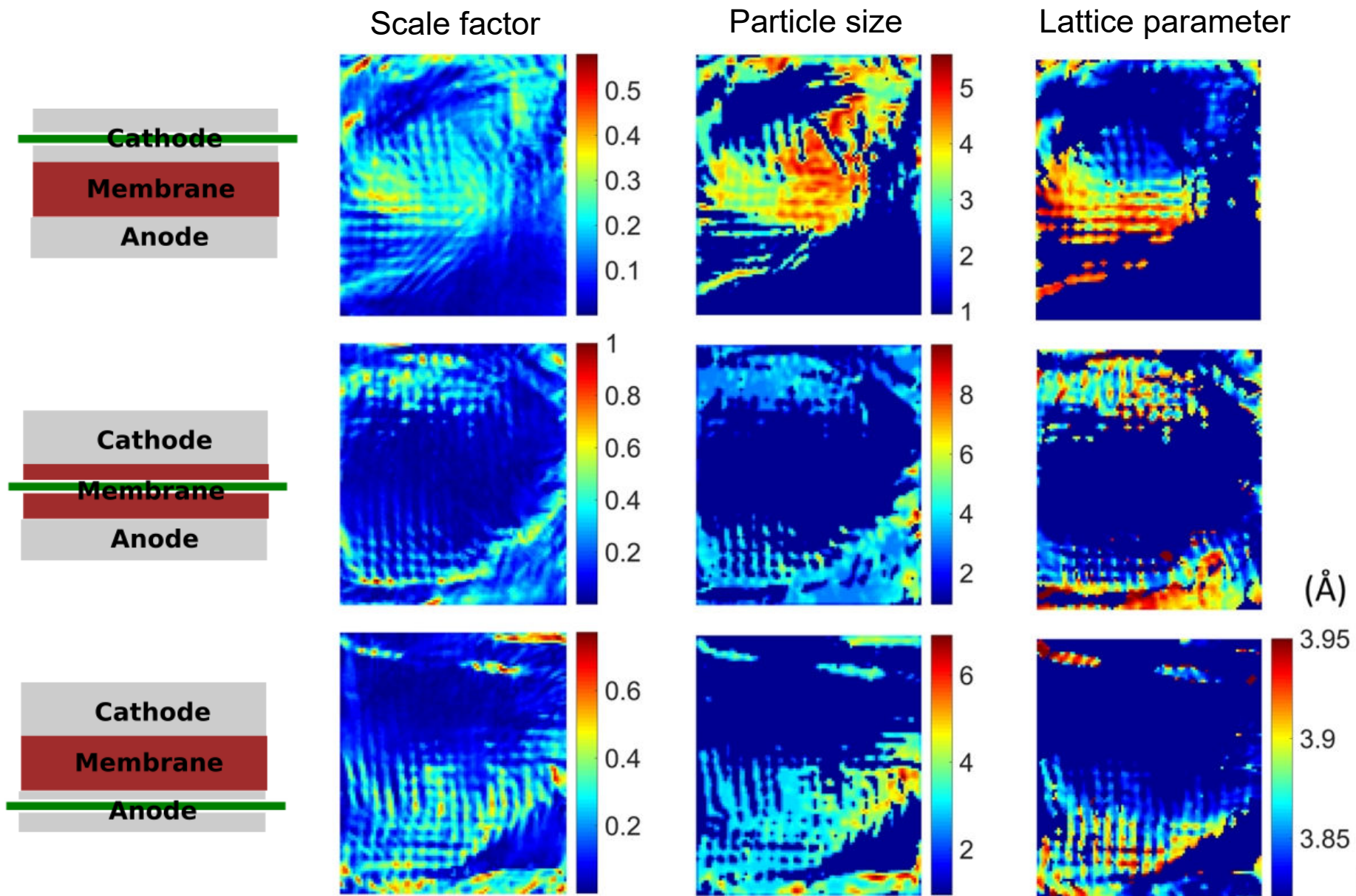


High Res

Low Res



XRD-CT Rietveld refinement

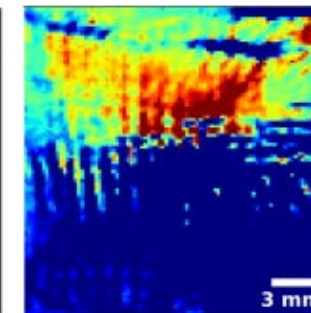
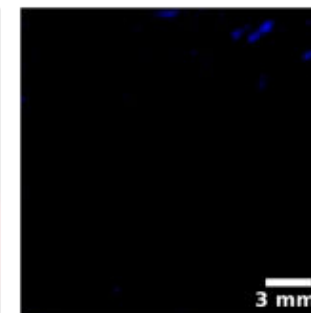
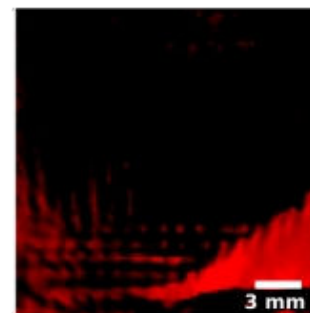
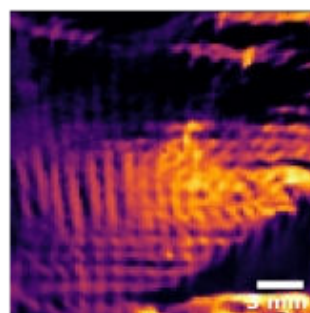
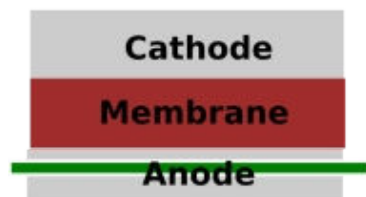
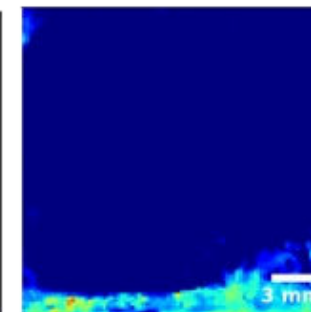
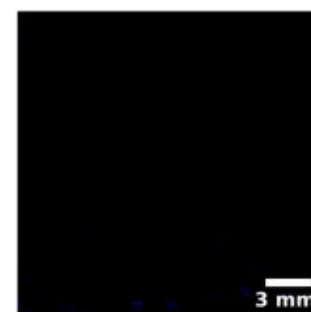
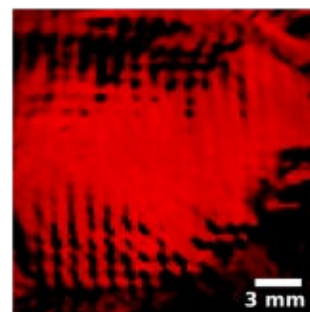
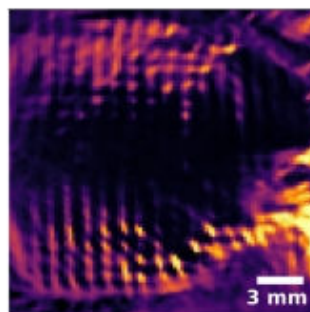
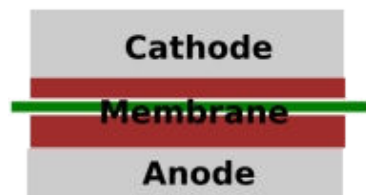
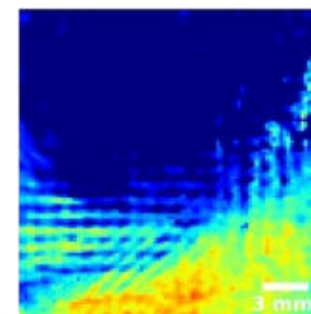
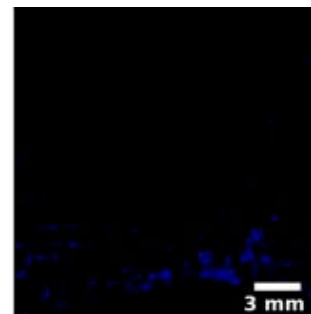
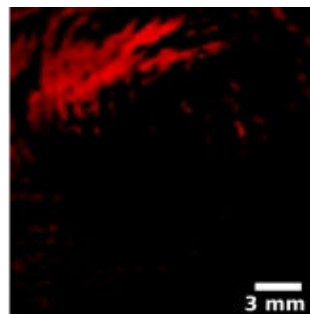
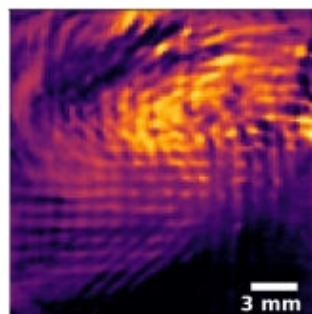
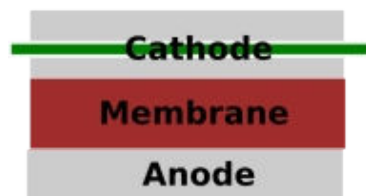


Pt

Nafion

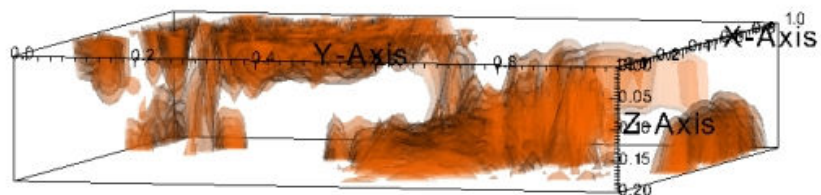
Water

Carbon

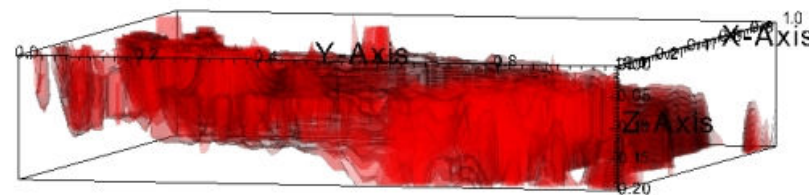


XRD-CT 3D rendering

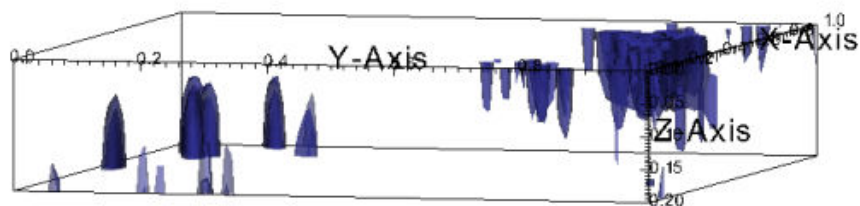
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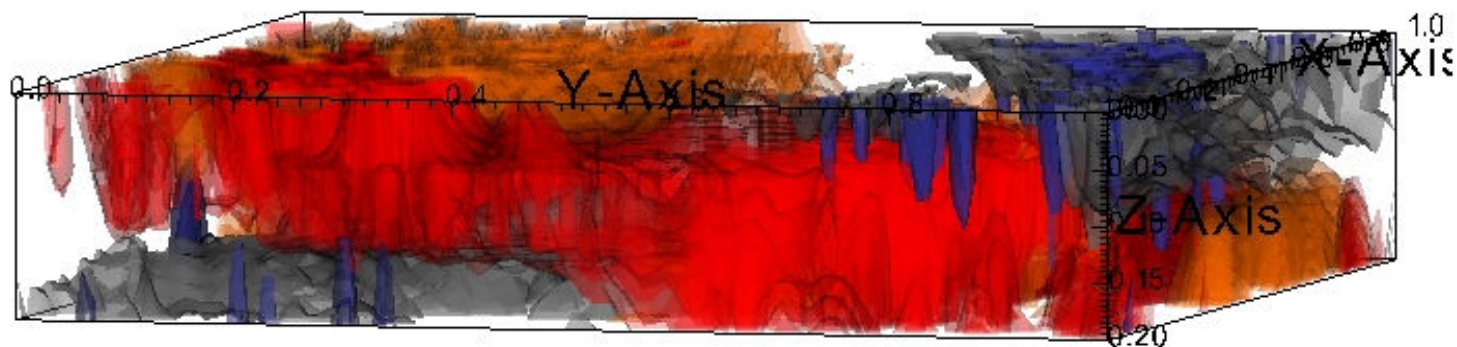
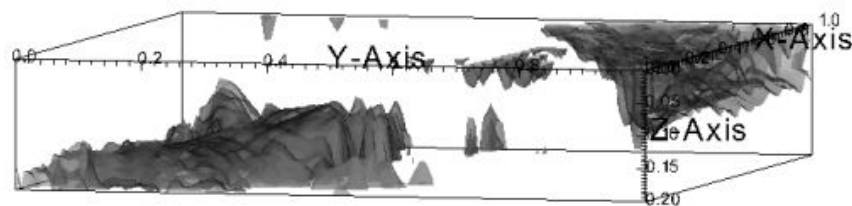
Nafion



Water



Carbon





- One click access to innovation accelerator
- 30 analytical techniques tailored for energy storage research available
- Physicochemical modeling of electrochemical systems
- Collaboration with expert team

Giant Battery Innovation



a unique collaboration bringing together



AT



#BATTERYATGIANT

#SAFETY #PERFORMANCE

The End.

Thank you for your attention.