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Sample environments and supporting infrastructure at the MEXs

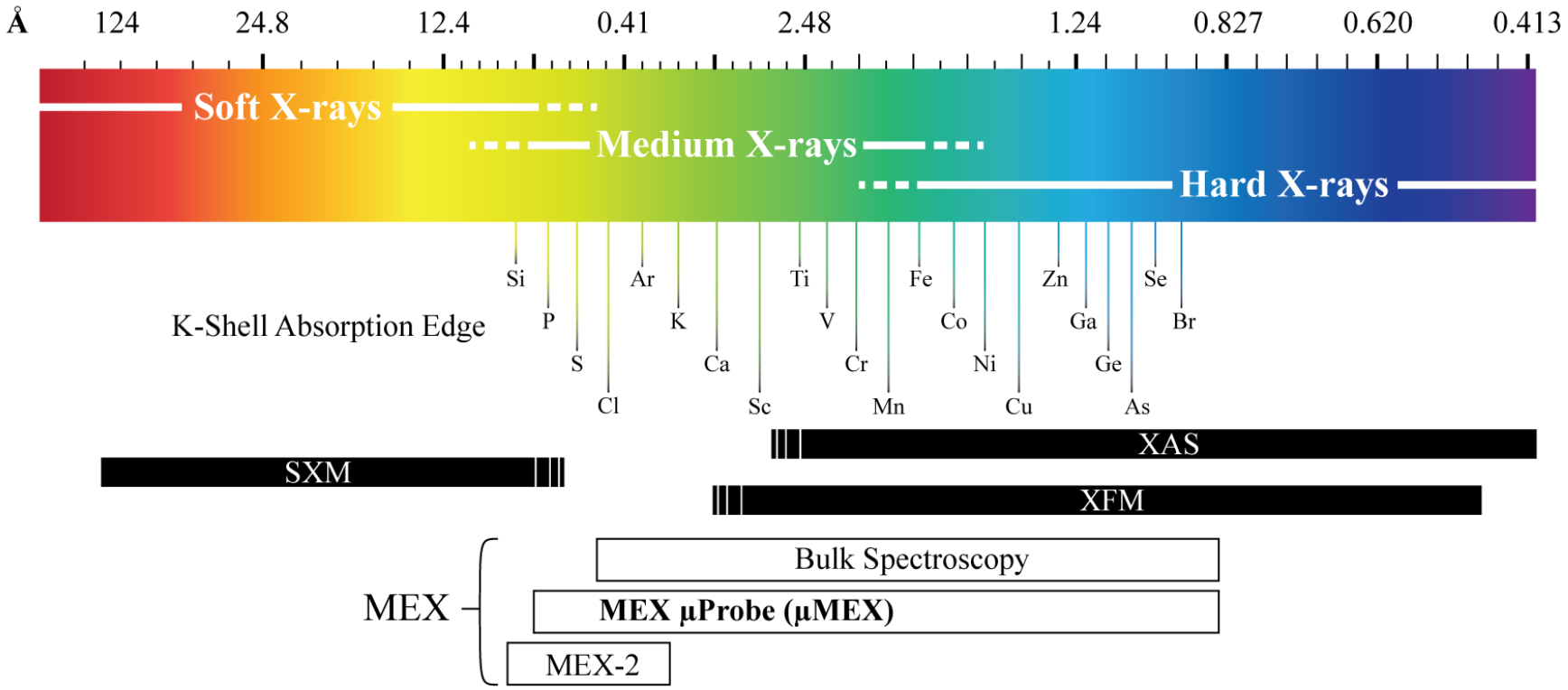
By Krystina Lamb, PhD(Chem)

Science. Ingenuity. Sustainability.

Nice to meet you

- I’m Krystina Lamb, that’s me there→
- My expertise is in Hydrogen energy technology
- Most recently from Griffith University Queensland Centre of Micro- and Nanotechnology
- Previously at CSIRO Energy and studied at the University of the Sunshine Coast
- Currently in the Blue Economy CRC hydrogen working group

A reminder: Accessible energies of MEX



- MEX 2 – 1.7 to 3.5 keV – Bulk and HERDF XAS
- µMEX – 2.4 to 12 keV – Microprobe
- MEX 1 – 2.1 to 13.6 keV – Bulk, HERDF and in-situ XAS, transmission and fluorescence

Sample environments

- Room temperature
- Vacuum (MEX 2 only)
- Cold finger/Stinger/cryocooled
- Furnace (see Emily's presentation)
- Microprobe (see Simon's presentation)
- Electrochemical cell – liquid or gas
- Capillary cell – liquid or gas
- BYO sample environment with access to supporting infrastructure;
  - Integrated gas handling system – Likely to have CO, CO2, H2, CH4 on hand, others on request - compatibility to be checked on application
  - Ventilation for hazardous gases/vapours – compatibility to be checked on application
  - Electrochemical work station and interconnections
  - Integrated liquid pumps with low pressure variation

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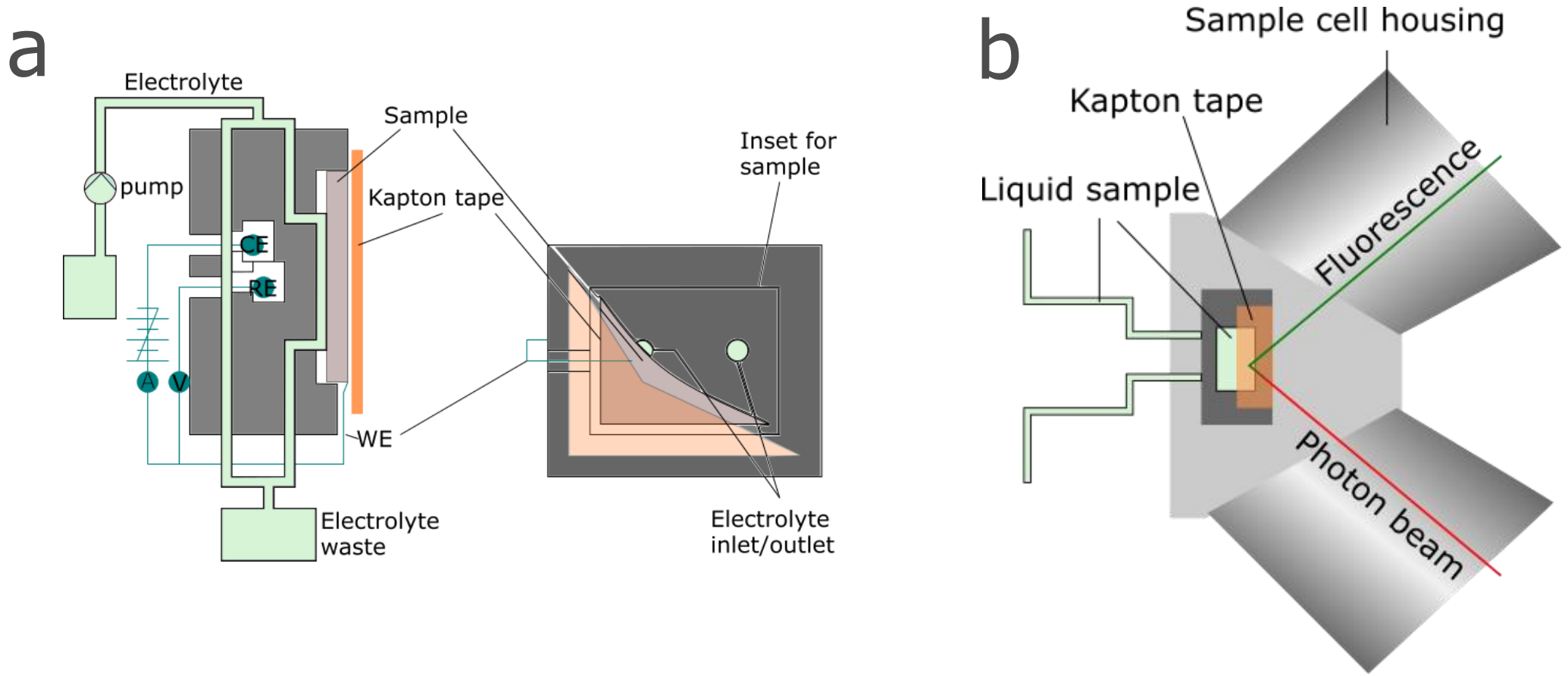
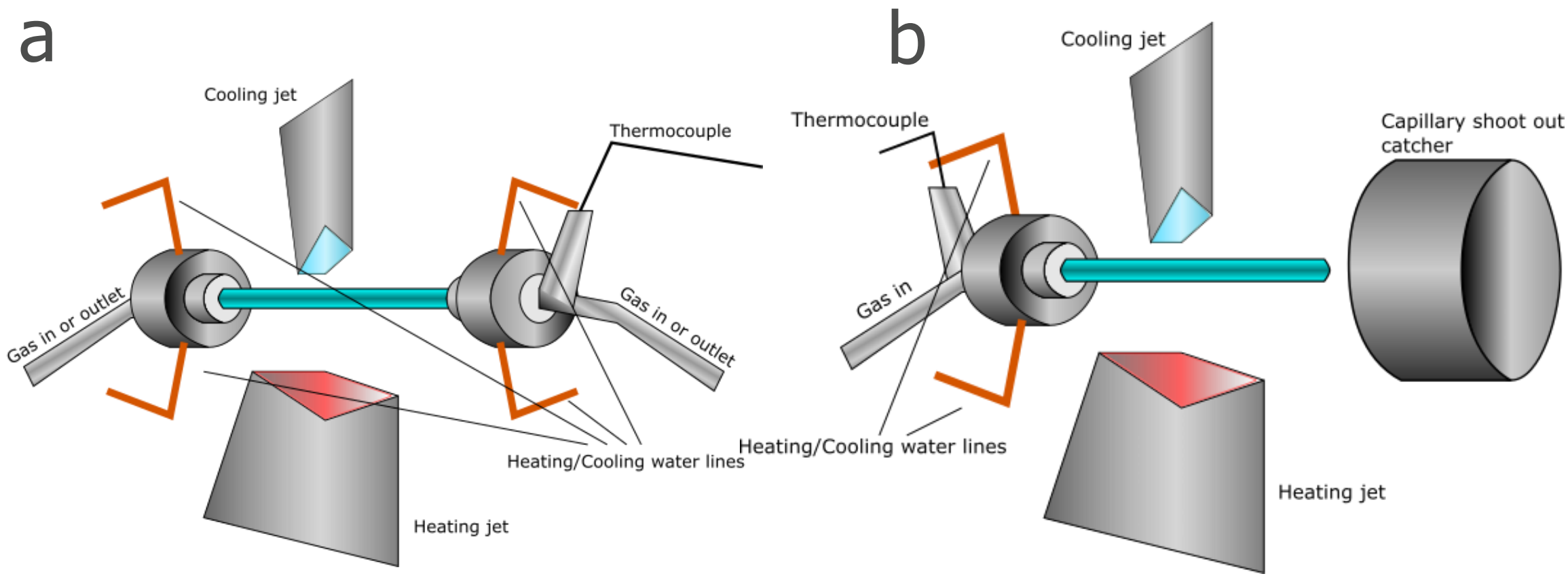
Planned sample environments at MEX – Electrochemistry cell



a) An example electrochemistry sample cell side and front deconstructed view (based on a compilation), and b) sample cell housing showing a flowing set up with no electrochemistry components (based on Hockings cell)

Planned sample environments at MEX – Capillary cell

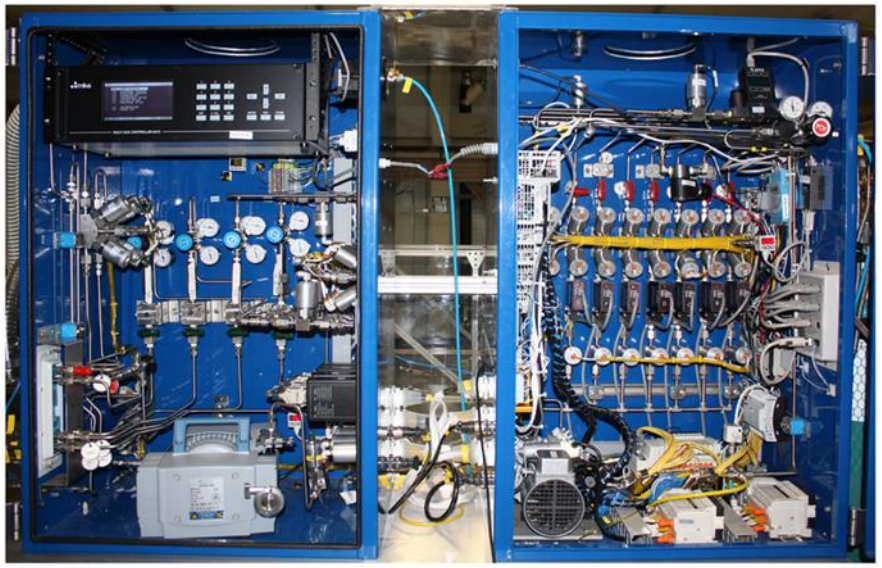


Capillary cell diagrams of a) flow-through and b) sealed.

Depending on user energy of interest, discussion regarding capillary material is required

BYO sample environment supporting infrastructure – Gas handling

- Currently in the process of designing
- Gas exhaust and extraction system
- Examples from other synchrotrons:



BYO sample environment supporting infrastructure – Electrochemical equipment

- Autolab multichannel potentiostat/galvanostat
- Exploring integration of Autolab controls into MEX user cabin PC

BYO sample environment supporting infrastructure – Liquid pumps

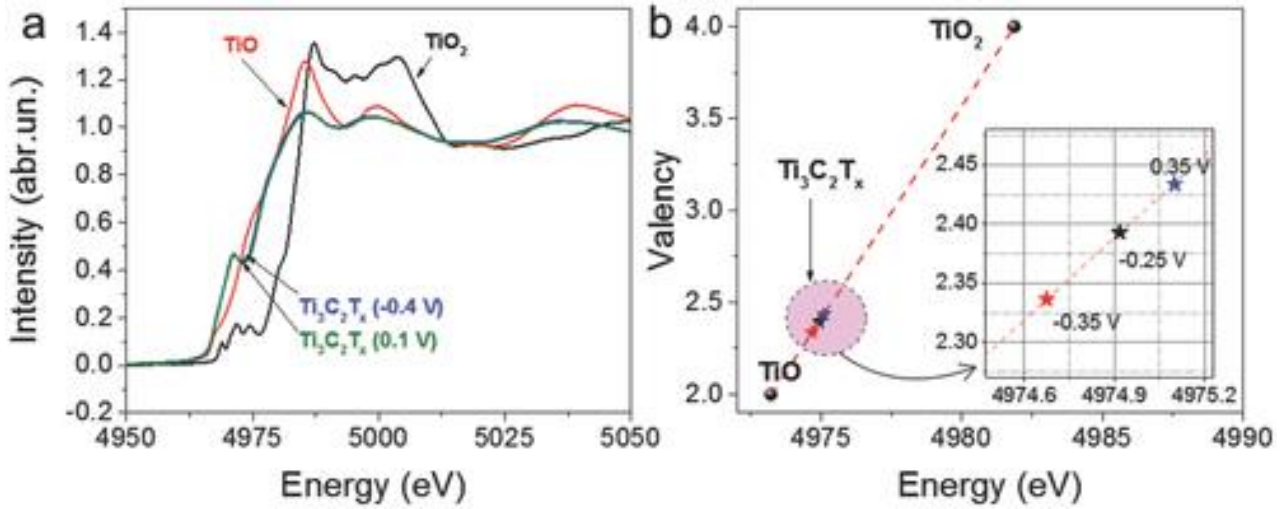
- Exploring purchase of syringe pumps to supply highly controlled liquid flow with minimal pressure variation
- Low flow rates to medium flow rates (exploring ~ 0.3mL to 50 mL per minute)
- Low pressure (less than 1 bar gauge) at this time

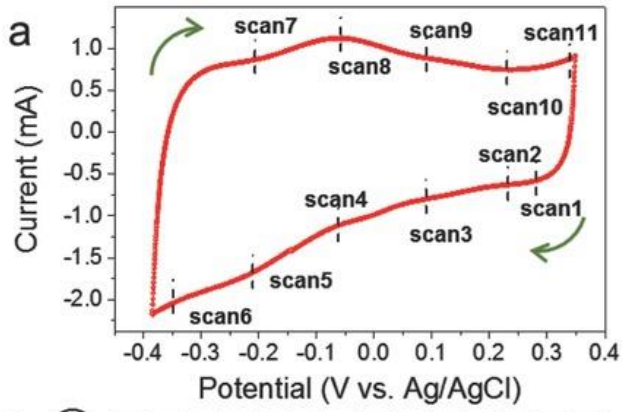
Examples from the literature - Electrochemistry

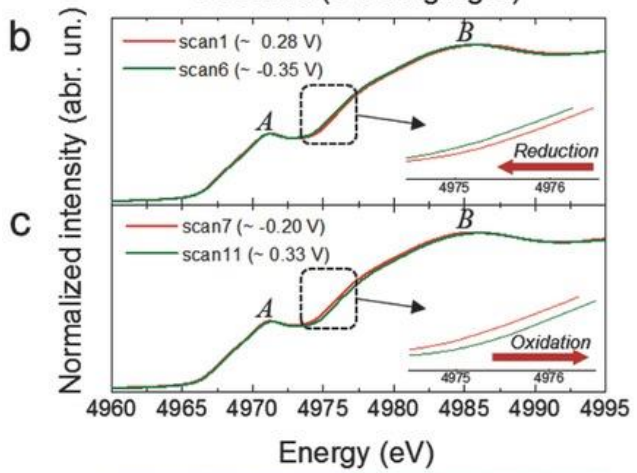
Probing the Mechanism of High Capacitance in 2D Titanium Carbide Using In Situ X-Ray Absorption Spectroscopy

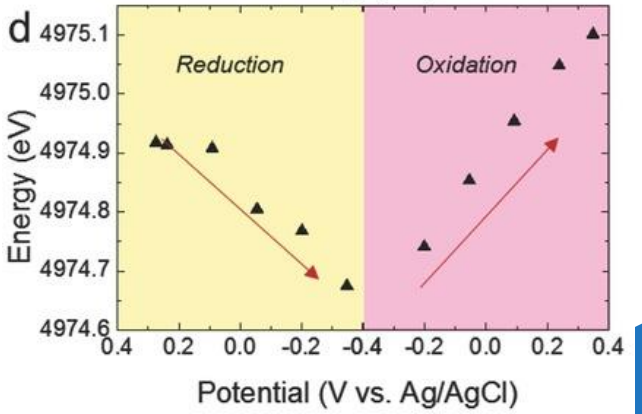
Maria R. Lukatskaya,Seong-Min Bak,Xiqian Yu,Xiao-Qing Yang,Michel W. Barsoum,Yury Gogotsi

https://doi.org/10.1002/aenm.201500589







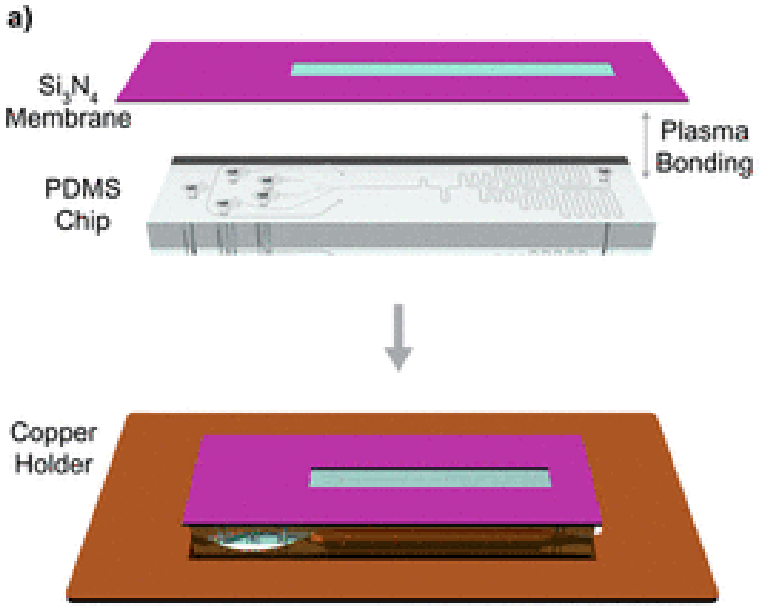


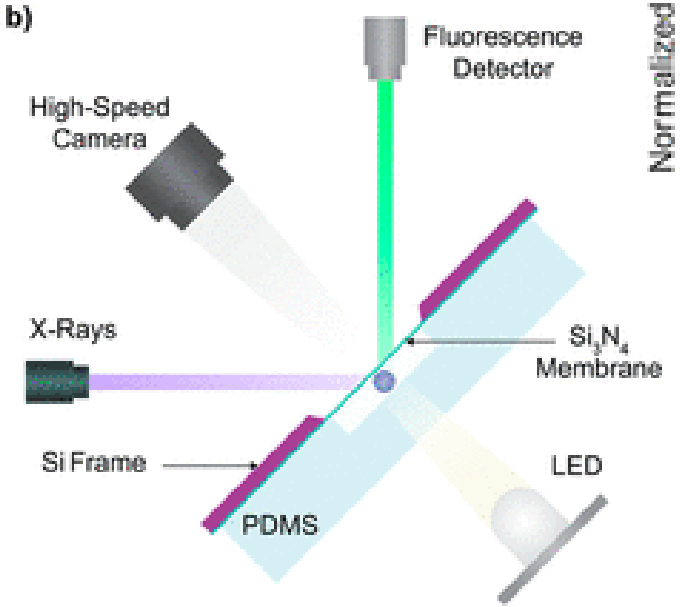
Example from the literature – In situ dynamic studies

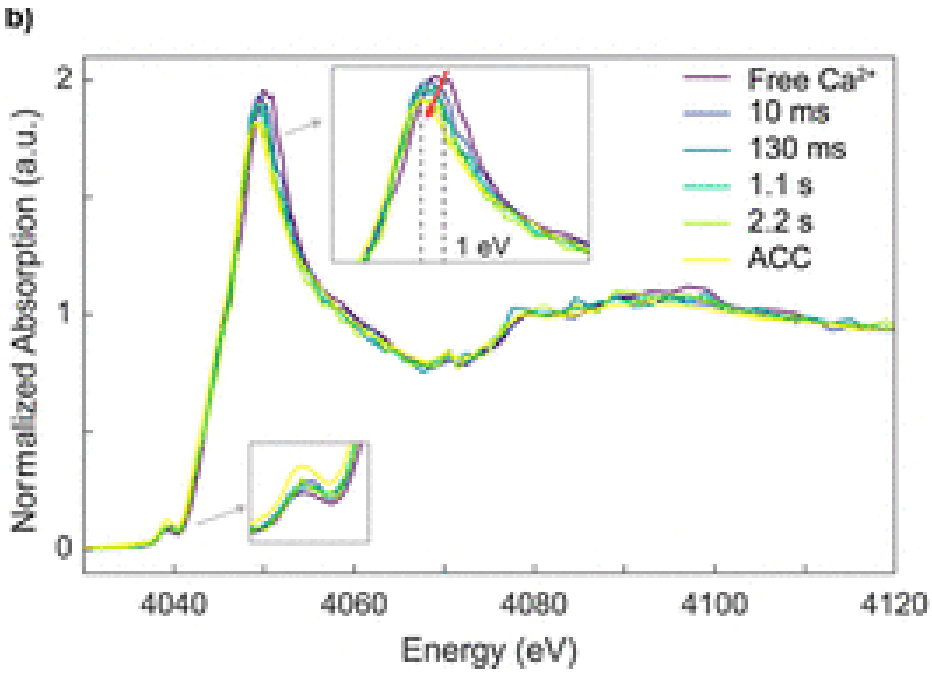
In Situ X-ray Absorption Spectroscopy and Droplet-Based Microfluidics: An Analysis of Calcium Carbonate Precipitation

Julie Probst, Camelia N. Borca, Mark A. Newton, Jeroen van Bokhoven, Thomas Huthwelker*, Stavros Stavrakis, and Andrew deMello

https://doi.org/10.1021/acsmeasuresciau.1c00005







Thank you for listening

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