

Mid-term Review

Update on novel flow cell for in-situ GIXAS

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Studies: Bachelor and Master at TU Wien

Background: Technical Chemistry

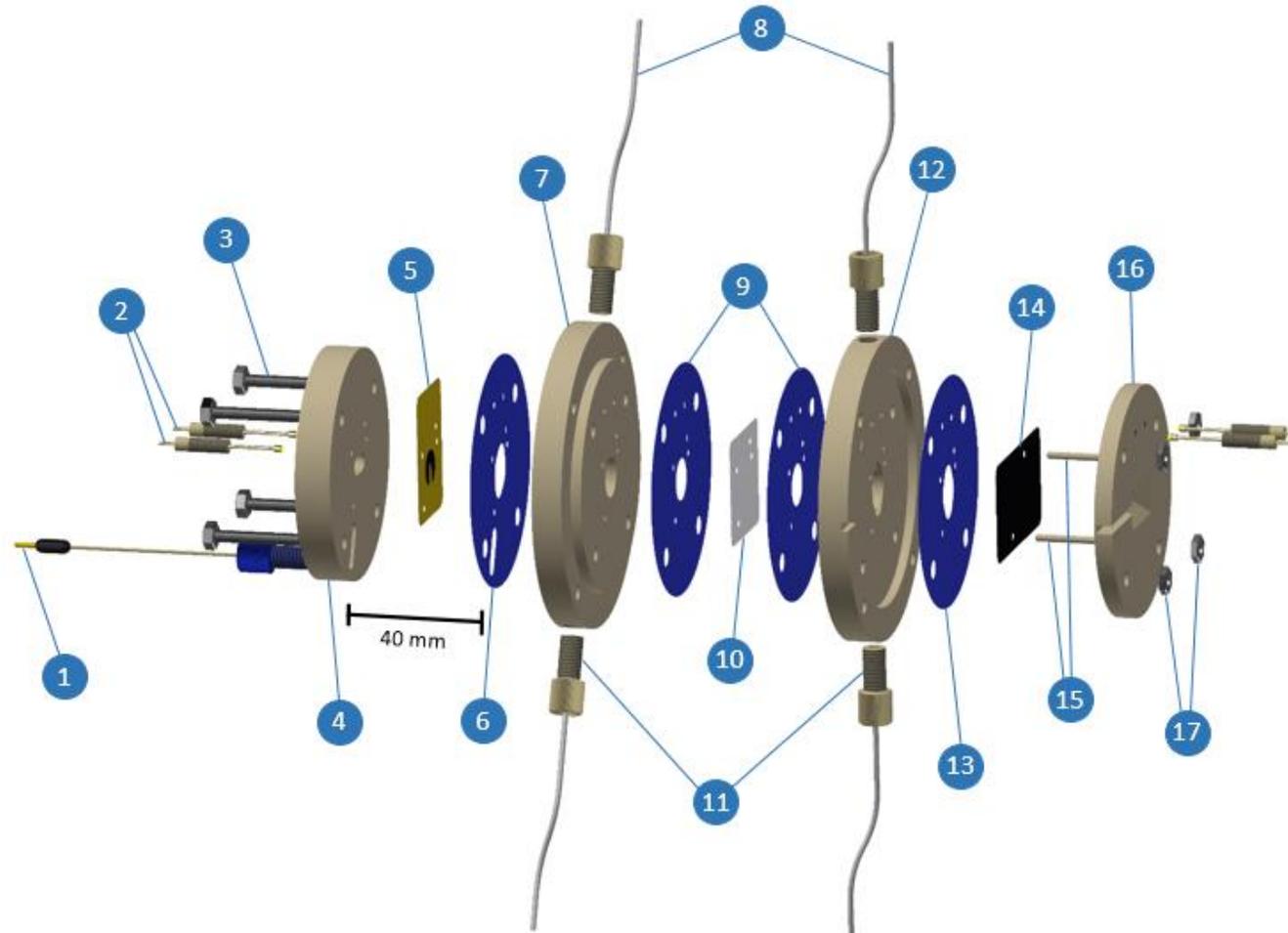
Research Field: Electrocatalysis



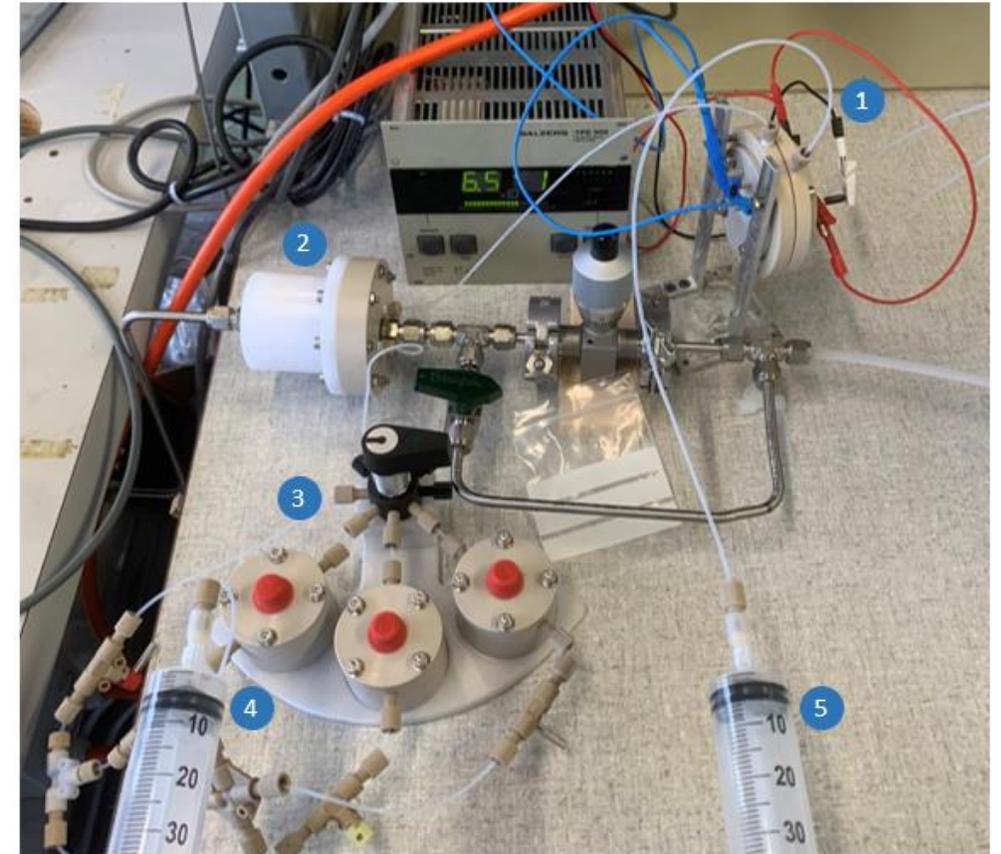
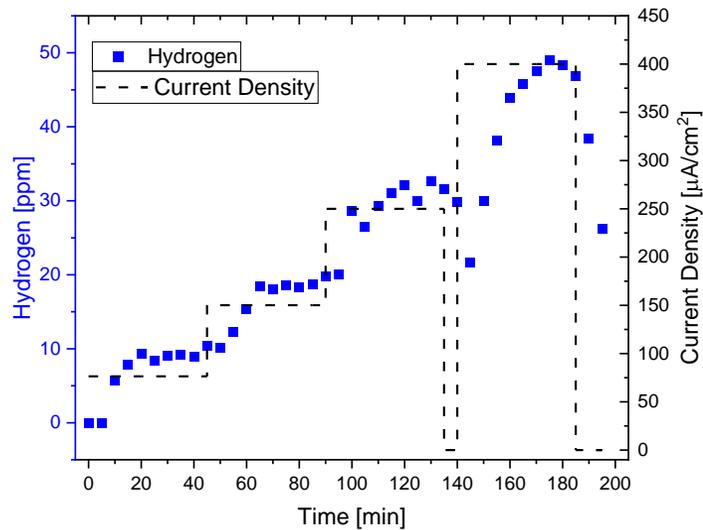
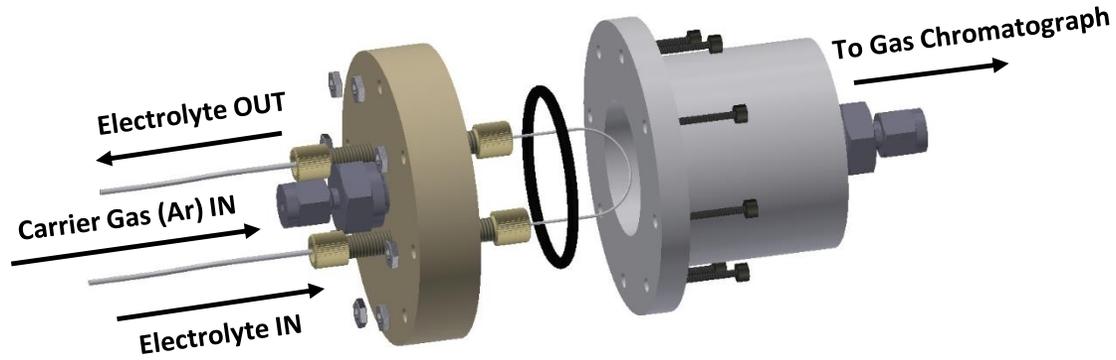
My Role in Catchy as ESR14:

- Institute: Paul Scherrer Institut (Switzerland)
- Electrochemical Testing of Clusters during CO₂RR conditions
- In-situ X-Ray Absorption Spectroscopy (XAS) during CO₂RR

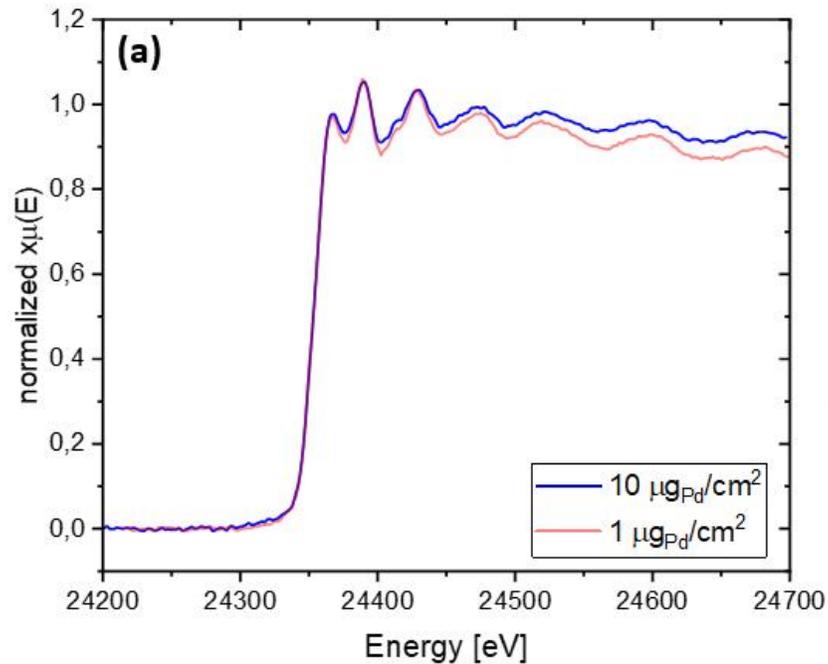
- New design of an electrochemical flow cell enabling in-situ grazing incidence XAS of cluster-based catalysts and product quantification (H₂, CO, HCOO⁻) during CO₂RR.



- Gaseous products (H₂ and CO) will be quantified by degassing them out of the electrolyte by applying vacuum along a porous PTFE tube.
- Formate is quantitatively analyzed by collecting the electrolyte in one of three different vessels and injecting it into an ion chromatograph.



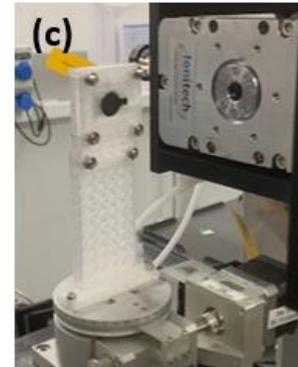
- Preliminary ex-situ XAS results for reference sample with a loading of 1 and 10 $\mu\text{g}_{\text{Pd}}/\text{cm}^2$ in grazing incidence configuration.



(b)



(c)

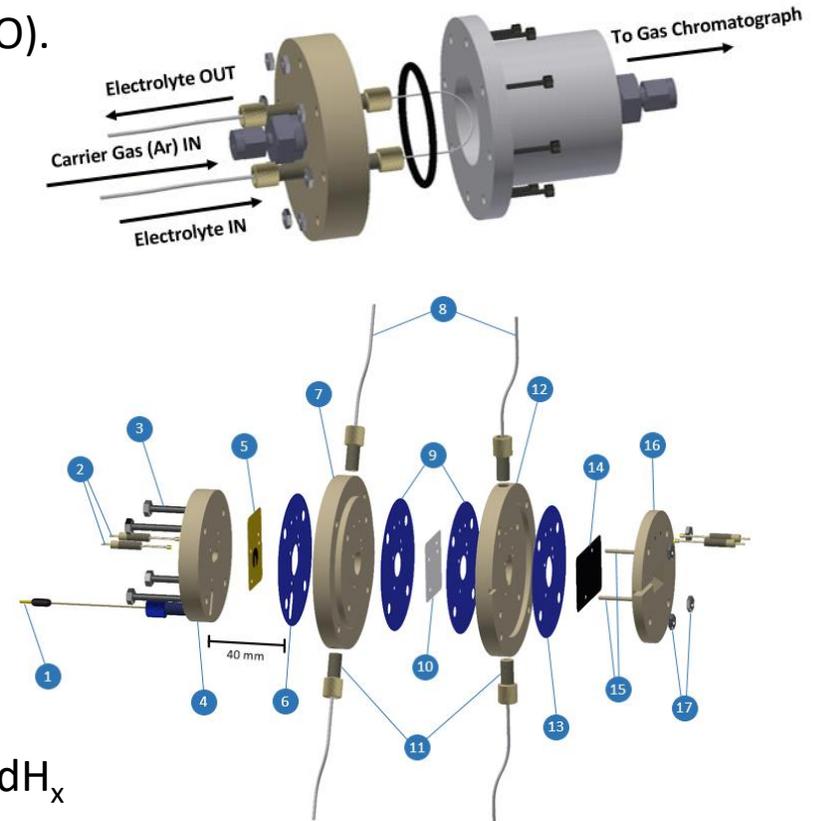


(d)



- ✓ For 10 $\mu\text{g}_{\text{Pd}}/\text{cm}^2$ spectrum with good signal to noise ratio could be acquired within 60 seconds by means of Quick XAS.
- ❖ For 1 $\mu\text{g}_{\text{Pd}}/\text{cm}^2$ over 2 hour of measurement time to acquire spectrum with similar signal to noise ratio.

- Calibration for gaseous product quantification by making use of Henry`s law (H₂, CO).
- Performing first CO₂RR experiments with commercial Pd/C catalyst to prove functionality of designed system.
- Submitted proposal for 2 days of beam time at SLS to validate the cell design and measurement procedures using a commercial Pd/C catalyst (10, 5 and 3 μg_{Pd}/cm²) and one Catchy sample (10 - 3 μg_{Pd}/cm²).
 - Ex-situ measurement
 - In-situ two potential hold at 0.0 and 0.4 V vs RHE to follow the formation of PdH_x



- Transmission Electron Microscopy Course - WS **(Training)**
- Atmospheric Chemistry Lecture - WS **(Training)**
- Lecture about Scientific Information Retrieval & Management - WS **(Training)**
- Presenting Catchy to the general public at the Marie Curie Event of Frascati Scienza **(Outreach)**

Future Plans:

- Physical Electrochemistry and Electrocatalysis Lecture - SS **(Training)**
- Course focusing on in situ X-Ray techniques from 15.6 to 29.6 **(Training)**
- Technical University of Denmark from 25.4 to 27.5 **(Secondment)**
- Gordon Research Conference - Renewable Energy: Solar Fuels from 7.5 to 13.5 - Poster **(Conference)**
- ESR5, ESR8 and ESR12 will come to PSI from 15.6 to 15.7 **(Secondment)**

Idea behind Catchy:

- Capture CO₂ from atmosphere or directly from exhaust of power plant.
- Energy source: Excess electricity from renewable energy sources as wind and solar power.
- Converting CO₂ into useful green chemicals
- Thermo- and electrochemical conversion of CO₂ needs catalyst because of high activation energy (1072 kJ mol⁻¹).

<https://www.catchy-etn.eu>

Thank you for your attention!