

Thermodynamics and Kinetics of Proton-Coupled Electron Transfer at Cerium-Based Structures Interfaces

Lyne Laribi of Noh Lab

Mentor: Miguel Liuzzi

07/23/2026

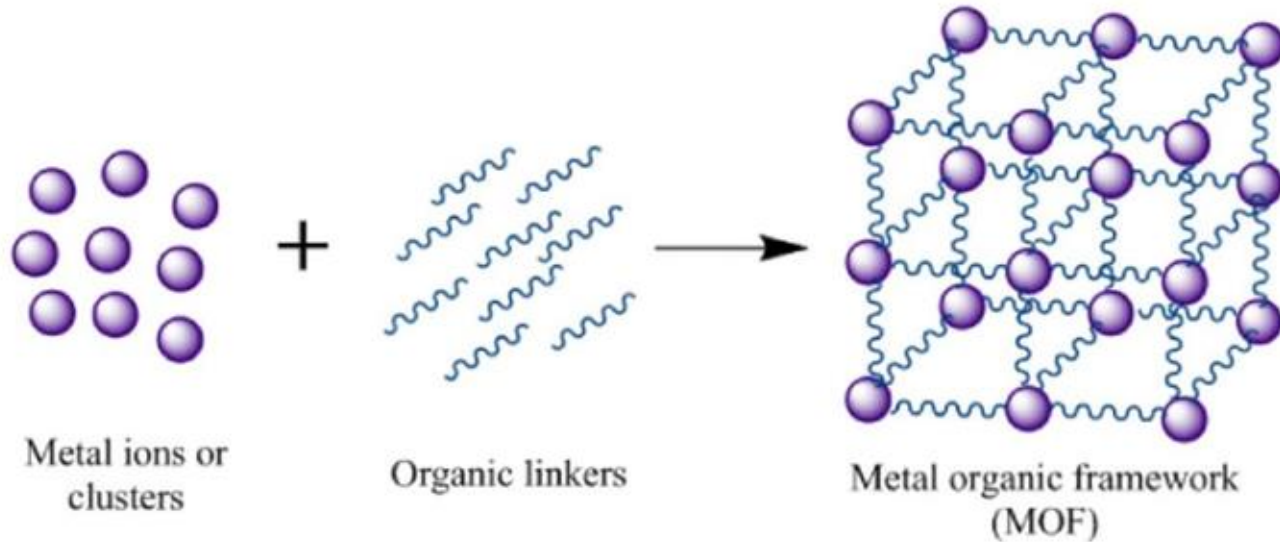
What are we trying to show?

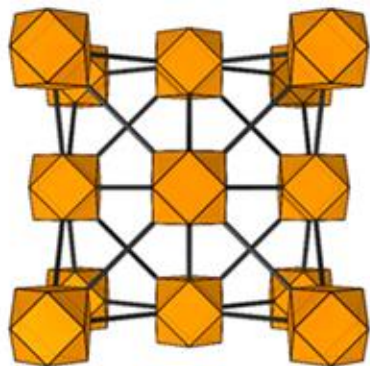
We want :

- To measure and understand how cerium-oxide structures grab and release hydrogen atoms at their surfaces when in contact with different chemical based buffers.
- To prove that both the solid material and the liquid it sits in are equally important players in determining catalytic behavior.
- We ask whether the liquid environment surrounding the Ce-oxo centers changes how fast this hydrogen atom transfer happens.

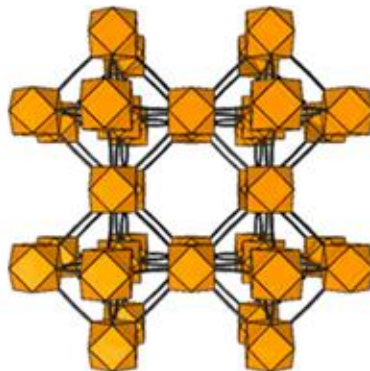


Metal Organic Frameworks (MOFs)

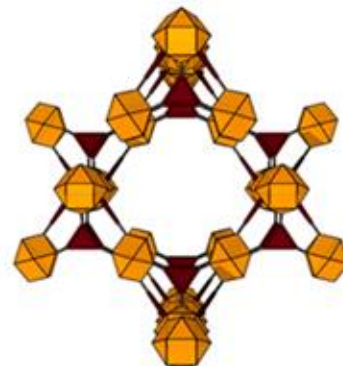




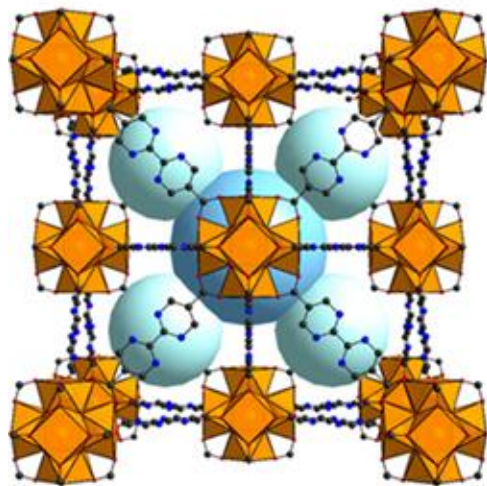
fcc



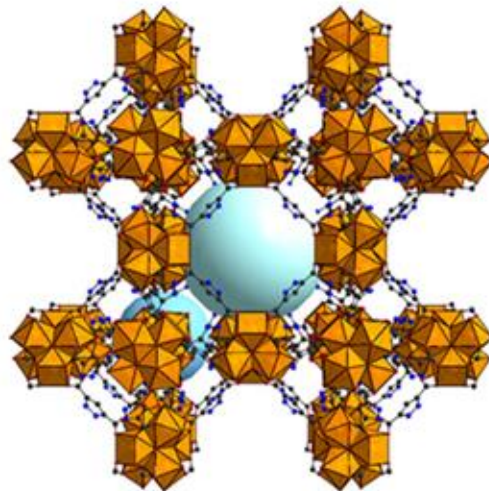
reo



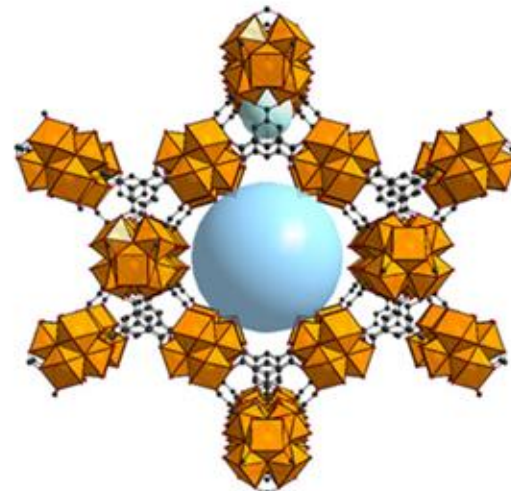
spn



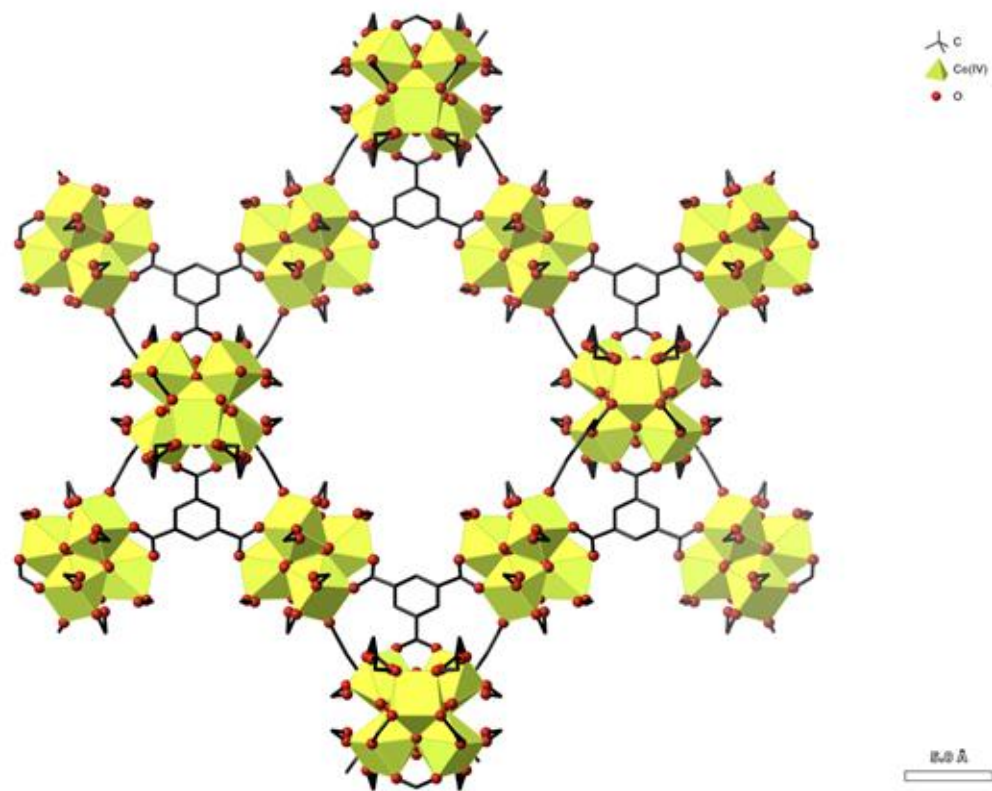
Ce-UiO-66-BPyDC



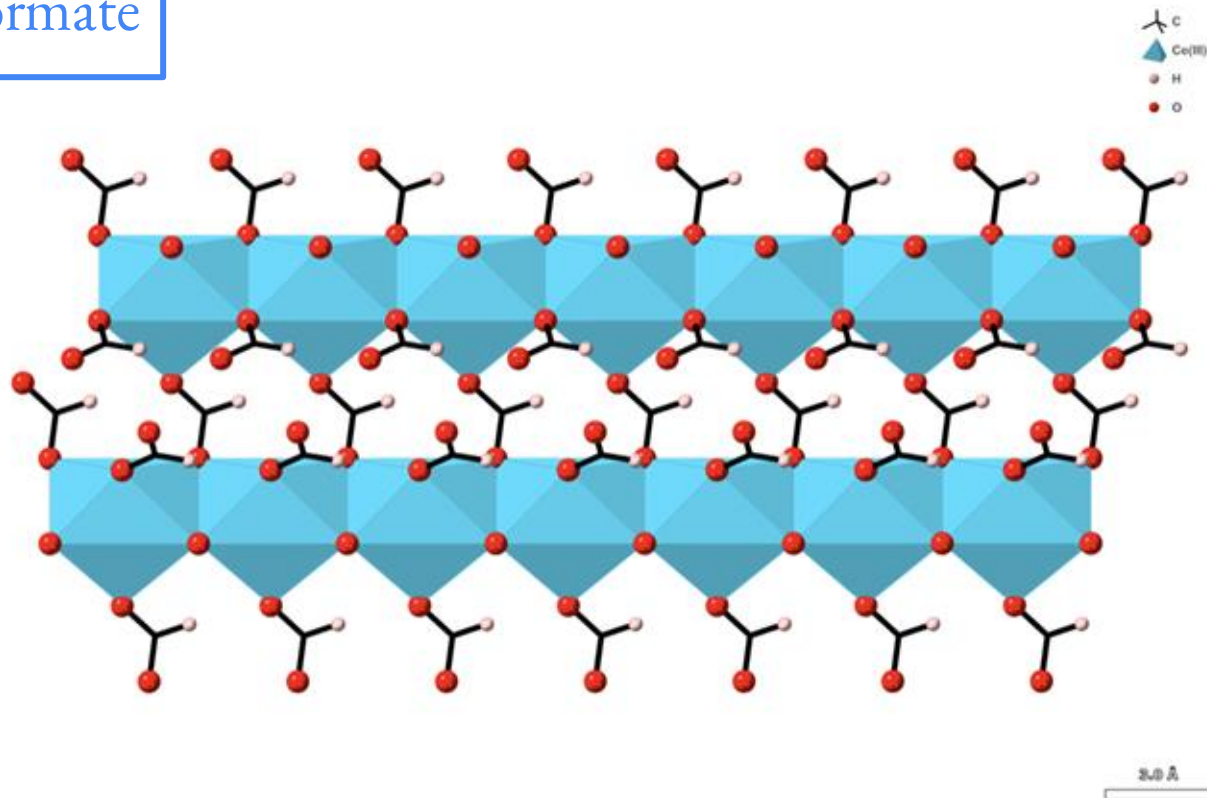
Ce-DUT-67-PZDC



Ce-MOF-808



Cerium Formate



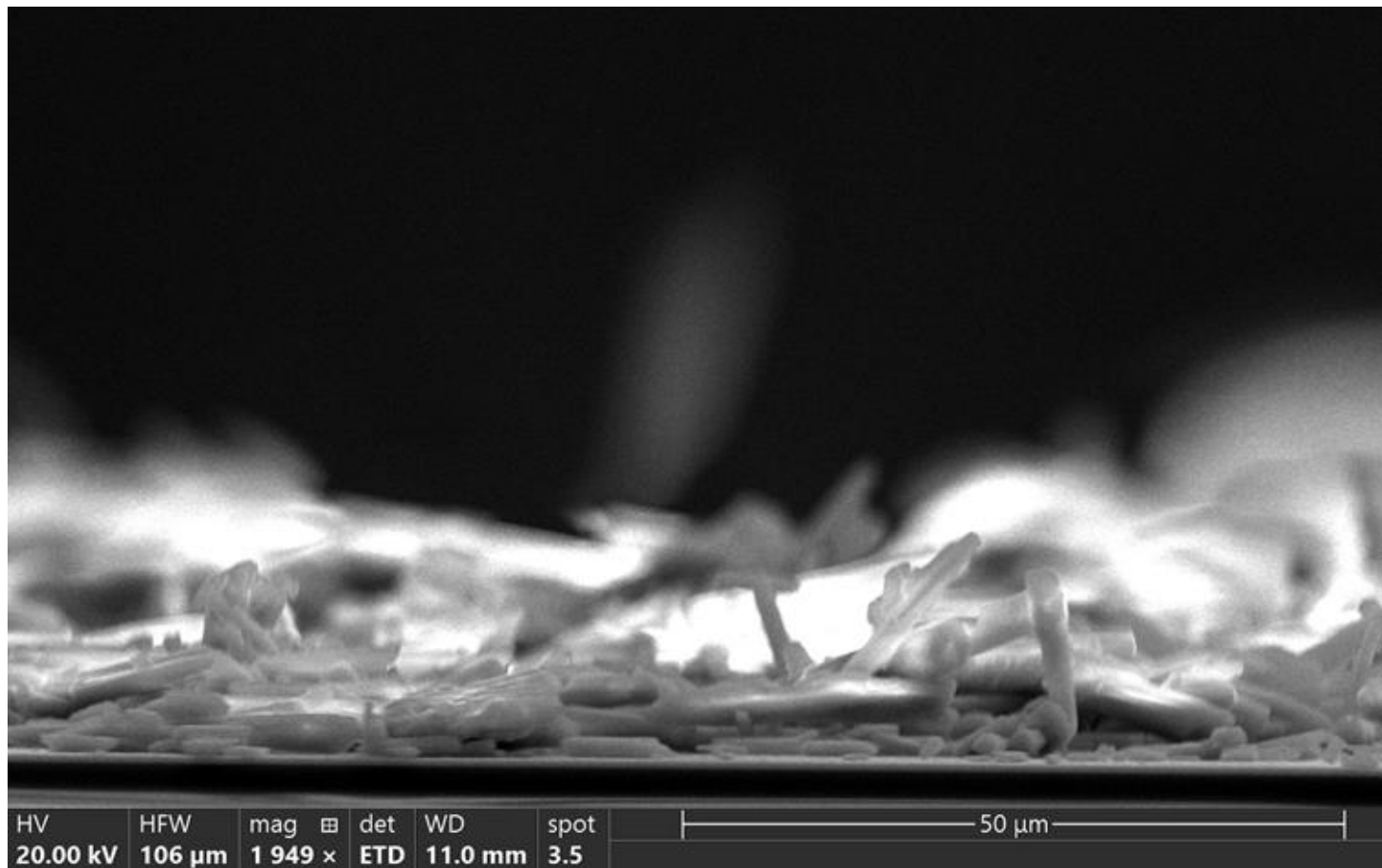
Methodology

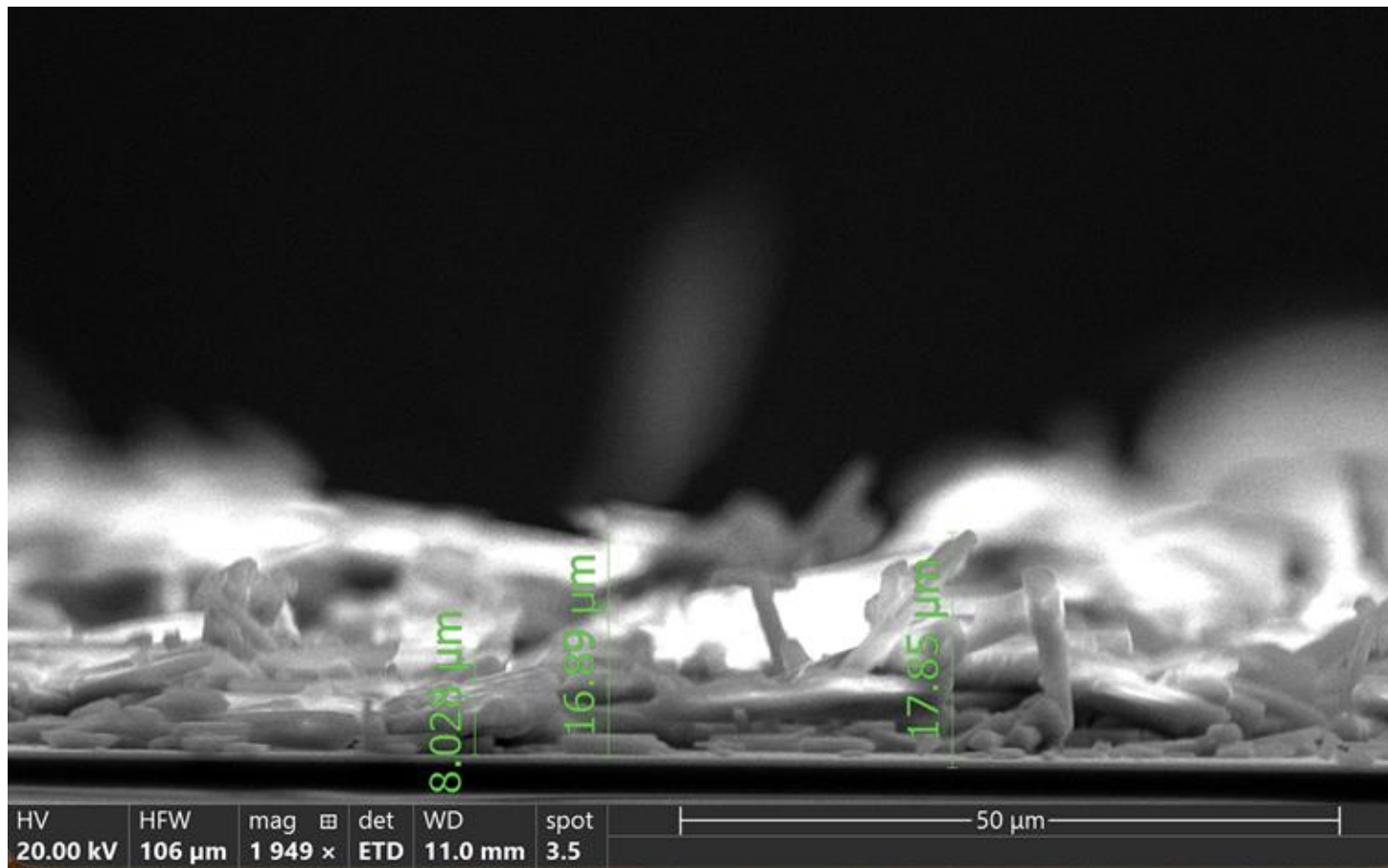
Cerium Formate / $\text{Ce}(\text{HCOO})_3$



Buffer Solution	pH
MOPS - $\text{C}_7\text{H}_{15}\text{NO}_4\text{S}$	6-8
Tris - $\text{C}_4\text{H}_{11}\text{NO}_3$	7-9
Boric Acid - H_3BO_3	8-10





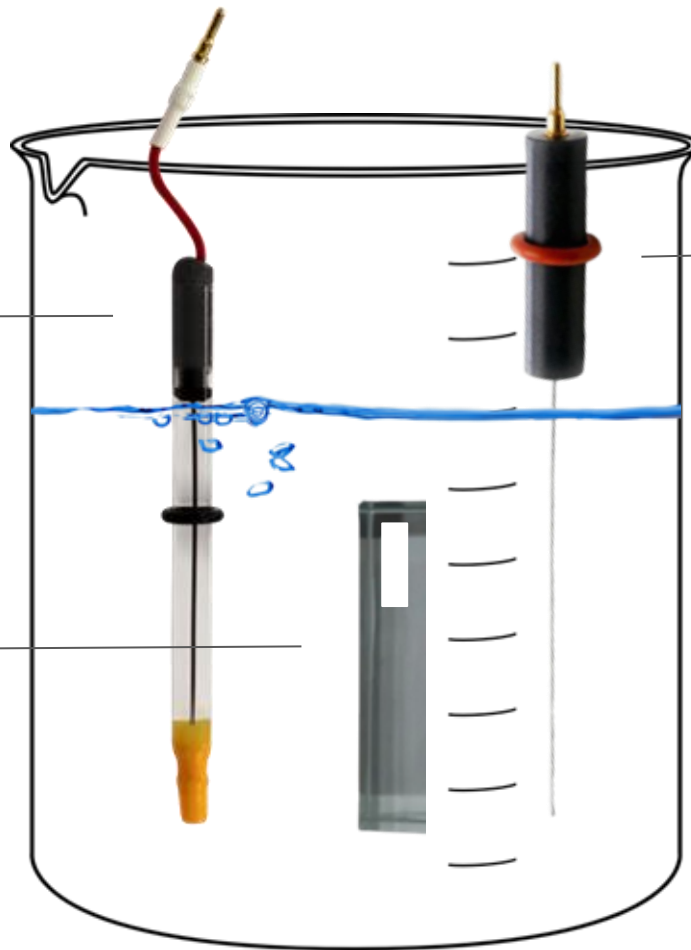


Methodology

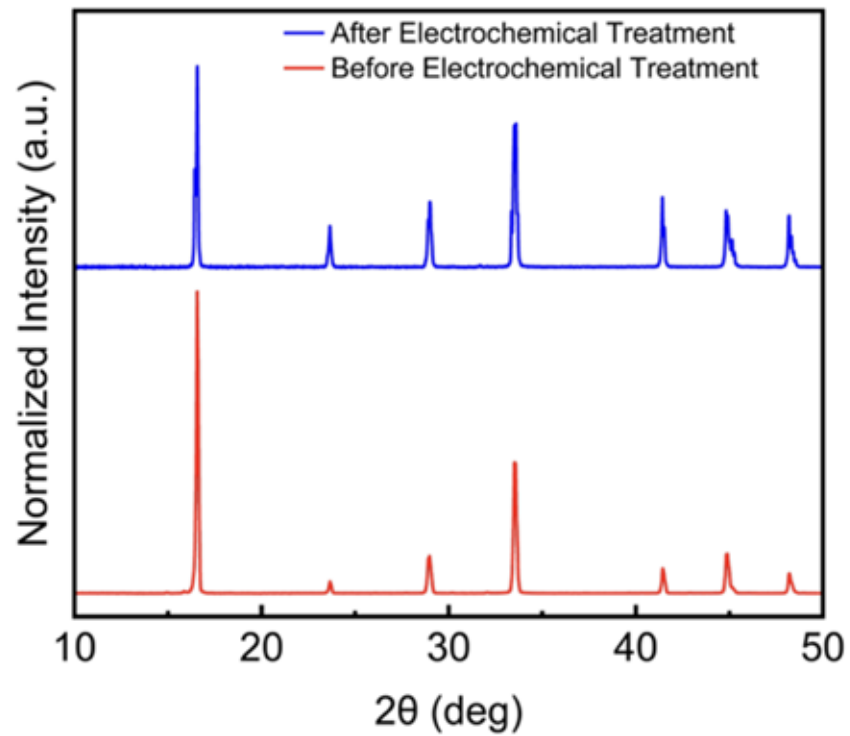
Reference Electrode

Electrode with Sample
(Cerium Formate)

Counter
Electrode



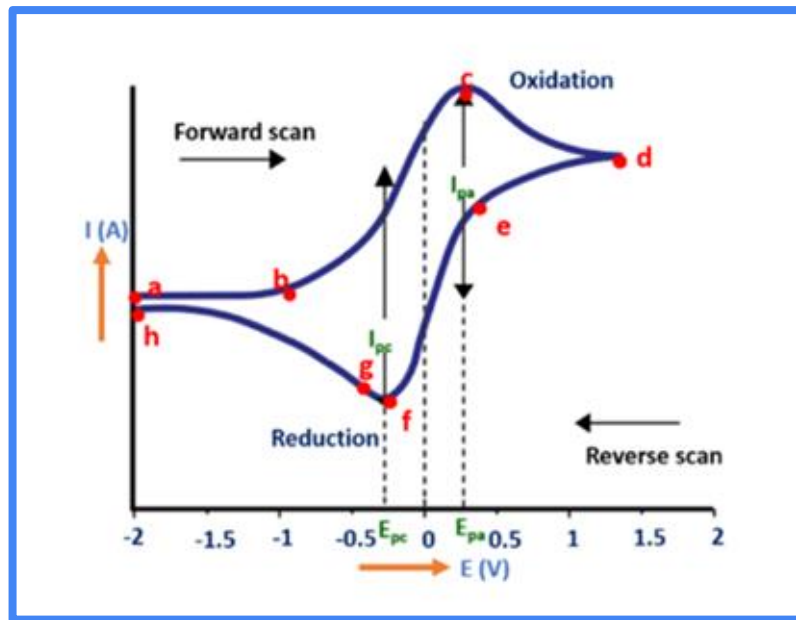
XRD Patterns

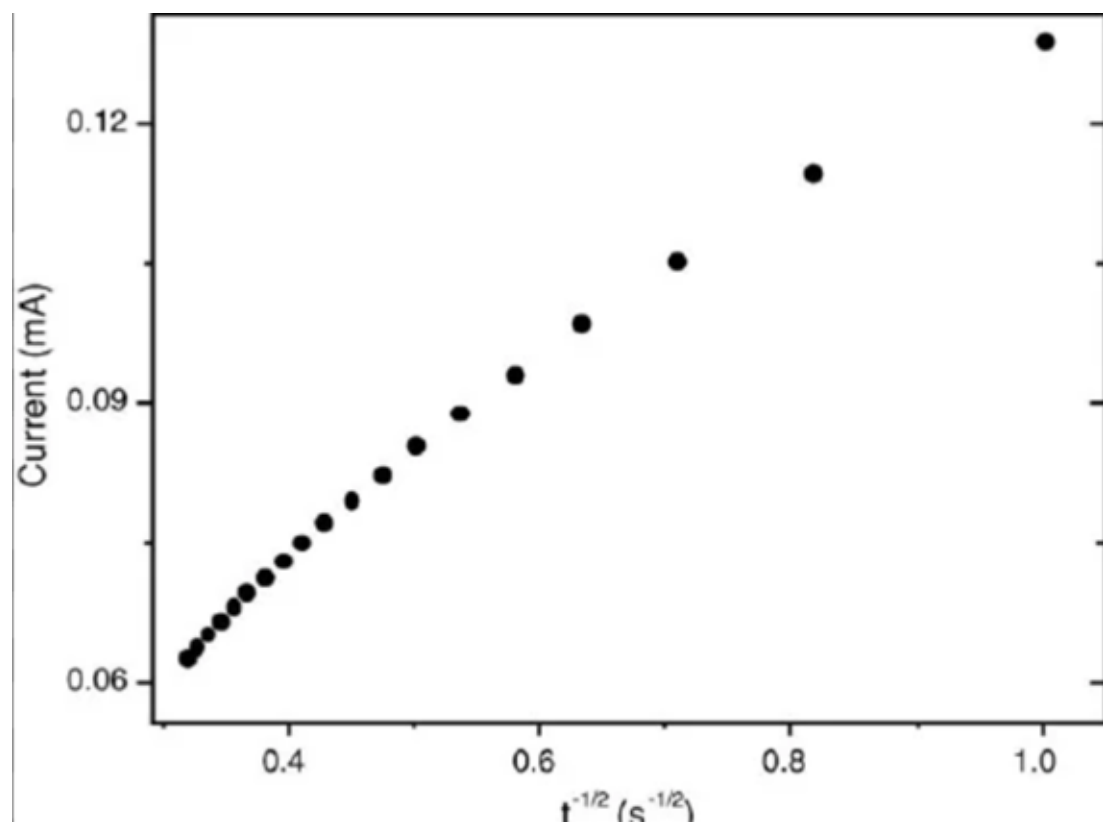


How did we show this?

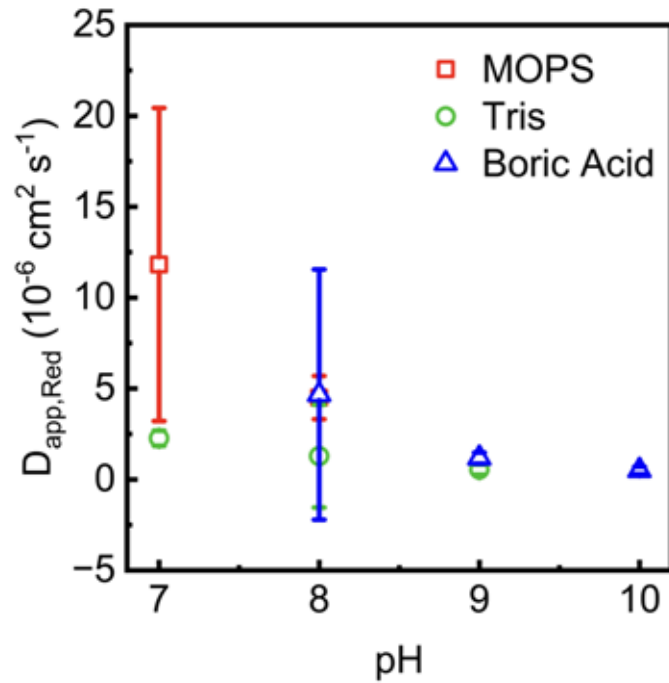
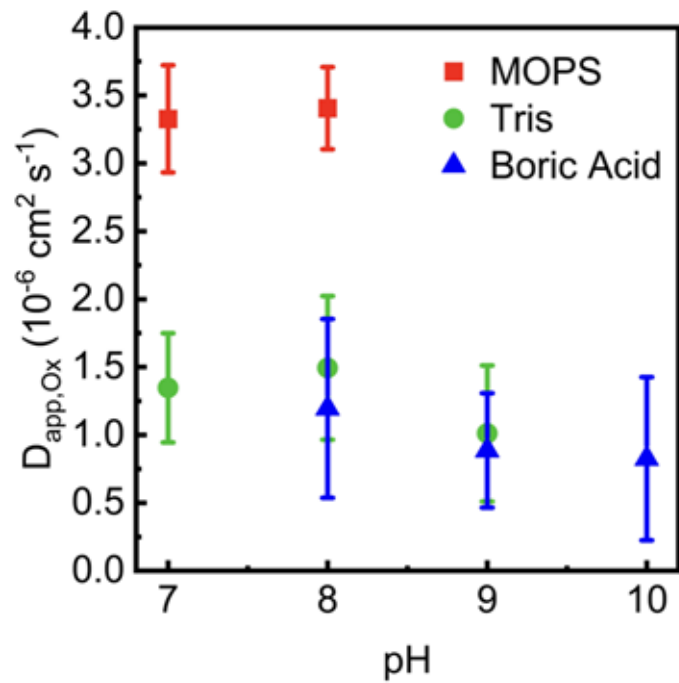
To measure the hydrogen atom binding strength...

- We put Cerium Formate onto electrodes and ran electrochemical experiments in buffers at different pH levels
- Using the way electric potential shifts with pH levels to calculate the BDFE directly.
- Cyclic voltammetry: we measured a passed current as a function of applied potential producing characteristic peaks that reveal the redox behavior and electron transfer rates of the cerium nodes within the structure





$$i = \frac{nFAC_0\sqrt{D}}{\sqrt{\pi t}}$$



Questions? Concerns?