Biography

Dr. Lisandro Cunci is an Assistant Professor in the Department of Chemistry at the University of Puerto Rico, Rio Piedras Campus in Puerto Rico, after working for 8 years at Universidad Ana G. Mendez, Gurabo Campus, a primarily undergraduate university (PUI). He received his bachelor's degree in Materials Science Engineering in Buenos Aires, Argentina in 2008 where he started doing research on electrochemistry during his last year working in wired and wireless corrosion sensors at Det Norske Veritas (DNV) in Dublin, OH during his engineering thesis under the mentoring of Dr. Sridhar Narasi. He obtained his Ph.D. in Analytical Chemistry in 2013 at the University of Puerto Rico under the mentoring of Dr. Carlos Cabrera developing nanomaterials as electrocatalysts for the oxidation of ammonia.

Dr. Cunci has been part of different research and education efforts with federal and state funding from the National Science Foundation, Department of Energy, National Institutes of Health, Department of Education, Puerto Rico Science, Technology, and Research Trust, among others. He has mentored more than 55 students in research in Analytical and Instrumental Chemistry thanks to the support obtained from all these funding sources. Dr. Cunci is currently the President-Elect of the Puerto Rico Chapter of the American Chemical Society and will be the President in 2024.

Research

Results by **Cunci's** group obtained in CHESS showed N-OLC/CoFe (3:1) obtained catalytic activities almost similar to commercially available Vulcan/Pt 20% (Figure 1A). This was due to the addition of the activity of N-OLC and the metal catalyst. However, *we have not been able to elucidate the contribution from each material to the reaction mechanism and how it changed to decrease the number of electrons involved.* It is highly important to study the catalysts using in situ experiments due to the intrinsic changes produced at different potentials. Using extended X-ray absorption fine structure (EXAFS) spectroscopy, **Cunci's** group measured the change in bond distance between metal-oxygen (1st coordination shell) and metal-metal (2nd coordination shell) for cobalt and iron in nitrogen-doped OLC/CoFe (3:1). All the experimental analysis was done by graduate students and the model

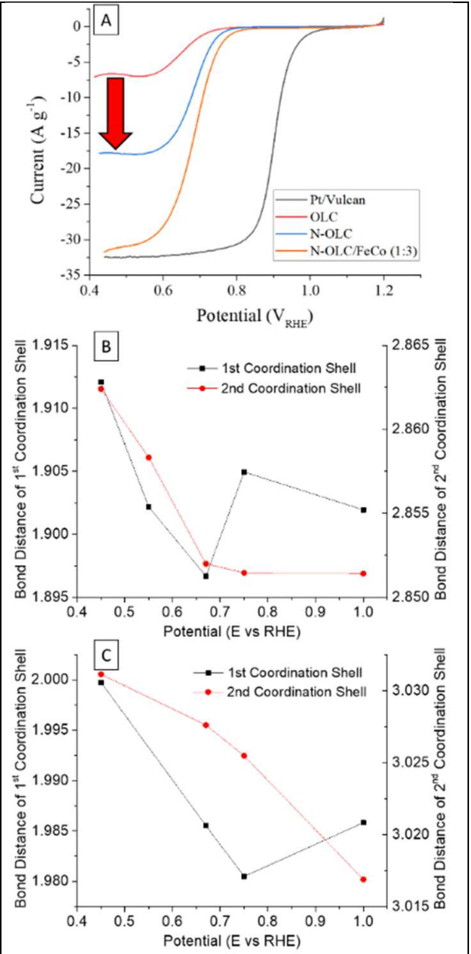

Figure 1 – (A) RRDE Generator/Collector experiment for ORR in O_2-sat 0.1 M KOH at 1600 rpm. Bond distances to the first and second coordination shells of (B) cobalt and (C) iron in N-OLC/CoFe (3:1) obtained using K-edge absorption, potentials applied vs Ag|AgCl and converted vs RHE.

fitting was done entirely by an undergraduate student, Kelvin Vicente, who learned this as part of a mentored summer internship showing the importance of these programs.

Figure 1B and Figure 1C show the increase in bond distance in the first and second coordination shell of cobalt and iron, respectively, with a cathodic potential scan from 1.0 V to 0.45 V vs RHE. In both metals the first shell corresponds to metal-oxygen bonds and the second shell corresponds to metal-metal (i.e. Co-Co and Fe-Fe, respectively) bonds. The increase in bond distance is expected to modify the rates of adsorption of OOH* and may change the O-O breaking from the direct OOH* dissociation to a hydrogen assisted OOH* dissociation into 2OH* as has been proposed for Fe/N/C.[1] Co/N/C and Fe/N/C have shown to have different mechanisms of reduction of oxygen with single atom catalysis and significant differences between experimental and theoretical values due to unknown mechanistic differences. *There is a knowledge gap between the mechanisms of the ORR and OER on bimetallic non-PGM as $M_1M_2/N/C$ where each metal has different mechanisms in monometallic systems. Is one mechanism favored or a combination of both mechanisms? Moreover, we showed an increase in the activity when bimetallic catalysts were used; therefore, is there a third mechanism pathway taken when both metals are together?*

Dr. Cunci's group has also developed an electrochemical cell for operando absorption and fluorescence-detected XAS that is fabricated very easily and economically using a hobbyist CNC. The CNC used to fabricate the prototypes and final electrochemical cell is in the PIPOX beamline for any user to take advantage. Additionally, the design files will be made available to the entire XAS community in a joint publication with CHESS. Dr. Chris Pollock has the files to share with any user interested in fabricating and using the cell. We have extensively tested the cell using different materials, including PTFE, acrylic, and PEEK without any leaks.

Goals at CHESS UEC

As part of the CHESS User Executive Committee, I will help in bringing the user's needs to CHESS management as well as the importance of this facility to the NSF. Increasing the number and diversity of CHESS' users will not only help bring a wider range of ideas together but also support the mission of the NSF. This will make CHESS more accessible and important for a wider community while increasing the visibility of the broader impact of CHESS to NSF. I will promote communication with all different scientific communities and collaborate in the organization of the Annual Users Meeting. As part of this pivotal period in energy matters, we must bring the knowledge and experience of the CHESS users to the help of the entire community.

(1) Zhong, L.; Li, S. Unconventional Oxygen Reduction Reaction Mechanism and Scaling Relation on Single-Atom Catalysts. *ACS Catal* **2020**, *10* (7), 4313–4318. https://doi.org/10.1021/acscatal.0c00815.