Tuesday, September 17, 2pm-4pm, IEM Conference Room

Understanding the Impact of p-Block Adatoms and Alkaline Metal Ions on Platinum Performance in Polyols Electrooxidation

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The efficient production of green hydrogen (gH2) is crucial for a sustainable energy transition. To reduce the costs associated with gH2 production via electrolysis, several challenges need to be addressed. For example, developing more efficient and stable anodes using accessible and widely available materials can help reduce capital and operational costs. The high overpotential required for water oxidation (OER, oxygen evolution reaction), including the most active materials for the reaction (Ir or Ru-based), is one of the main factors limiting the efficiency of these devices. In this context, replacing the OER at the anode in electrolyzers with the oxidation of biomass-derived substances can enhance overall efficiency by reducing the energy requirements of the devices and potentially producing valuable chemicals [1-2].

To produce a target chemical in an efficient and sustainable way, it is important to maximize the reaction activity and selectivity. This can be achieved by optimizing various components of the electrochemical device, including the electrode and electrolyte. Several biomass-derived molecules can be converted into valuable products, including various poly- and monosaccharides and polyols. In this context, glycerol, which is a model molecule for the oxidation of polyols and an abundant byproduct of biodiesel production [2], emerges as an interesting molecule for both fundamental and applied studies in this field.

Numerous studies have been published over the last few decades on the electro-oxidation of small organic molecules, using electrodes ranging from model surfaces like single crystals, which focus exclusively on fundamental aspects, to carbon and stainless steel, which focus on the viability of large-scale applications. It is well known that alcohols and polyols are oxidized on Pt- and Pd-based materials in alkaline media at much lower potentials than on materials based on non-noble metals [1]. Consequently, many studies have been conducted on these systems over the last few decades. However, many fundamental questions remain open in the field, such as how the structure of the catalysts influences the activity and selectivity and what role the electrolyte plays in the electrochemical reaction.

Therefore, in this talk, I will present results from my research group on the electro-oxidation of glycerol. I will focus on results obtained with polycrystalline Pt and analyze some fundamental aspects of the modification of the electrode by p-block adatoms and the effect of alkaline metal ions.

References:

[1]P.V.B. Santiago, S.P. Raju, K. Akkiraju, R.A. Vicente, M.A. da Silva, S. Yuan, D. Zanchet, Y. Shao-Horn, P.S. Fernández, ACS Appl Energy Mater. 6 (2023) 7025–7051.
[2]C. Coutanceau, S. Baranton, Wiley Interdiscip Rev Energy Environ. 5 (2016) 388–400.

Pablo S. Fernández received his B.Sc (2006) and Ph.D. (2011) in the Research Institute of Theoretical and Applied Physical Chemistry (INIFTA) at the University of La Plata, La Plata, Argentina under the supervision of Profa. Maria E. Martins. During 2012-2014 he was a postdoctoral fellow at the same institution. In 2014 he joined the Electrochemistry Group at the Chemistry Institute of São Carlos, USP, where he worked as a Postdoc with Prof. Germano Tremiliosi-Filho until August of the same year when he was appointed Assistant Professor at the Chemistry Institute of the University of Campinas (UNICAMP). Between 2010 and 2013 he visited the group of Prof. Giuseppe Câmara (UFMS-MS) where he worked intensively with FTIR in situ. From 07/2015 to 03/2016 he joined the Catalysis and Surface Chemistry Group, at the University of Leiden (The Netherlands) working under the supervision of Prof. M.T.M. Koper. He is currently an Associate Professor at Unicamp, head of the Campinas Electrochemistry Group (CampEG) and an active member at the Center for Innovation on New Energies (CINE). He was the Director of the Physical Chemistry Division of SBQ (Brazilian Chemical Society, 2020-2022). Since 2020 is the Brazilian representative of the SIBAE (Ibero-American Society of Electrochemistry). His research focuses on fundamental aspects of electrochemistry and electrocatalysis with an emphasis on the use and development of in situ characterization tools.