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From an Initial Hypothesis to Unexpected Discoveries: How Results Transform the Direction of a Project

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In this talk, I will provide a brief introduction to my group's research lines in fundamental and applied electrocatalysis, and then focus on an aspect I consider essential in scientific practice: how experimental results, especially those not foreseen, can completely redefine the direction of a project.

The first example will address the electrooxidation of glycerol—an abundant derivative of biomass and a byproduct of the biodiesel industry—in alkaline and anion exchange membrane (AEM) electrolyzers. The project began with a clear hypothesis: to use silver as a support for small amounts of noble metals, which would be the true active sites of the reaction. However, experiments revealed that, under certain conditions, the silver itself could behave as a highly active and selective material, generating value-added products while green hydrogen was produced at the cathode. This unexpected turn not only modified the original scientific approach but also led to the filing of a patent and opened new questions about the dynamic role of materials under operating conditions.

In the second case, driven by the success obtained with glycerol, we extended the study to the electrooxidation of ethylene glycol, a molecule that can be obtained from the chemical degradation of PET bottles and which is part of circular economy strategies. We started from the hypothesis that the behavior would be analogous to that of glycerol. However, we found that silver is practically inactive for ethylene glycol, which invalidated our initial assumption. This discrepancy gave rise to a systematic study on how molecular structure, the position and number of hydroxyl groups, as well as experimental variables such as potential and the electrolytic medium, determine the activity and selectivity in the oxidation of alcohols and polyols.

Pablo S. Fernández 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.

He 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 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.

