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Platinum surface instabilities and their impact in electrochemistry

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List of Publications

Chapter 2

F. Valls Mascaró, I. McCrum, M. T. M. Koper, and M. J. Rost, *J. Electrochem. Soc.*, **169**, 112506 (2022), *Nucleation and Growth of Dendritic Islands during Platinum Oxidation-Reduction Cycling*.

Chapter 3

F. Valls Mascaró, M. T. M. Koper, and M. J. Rost, *Step Bunching Instability and its Effects in Electrochemistry: Pt(111) and its Vicinal Surfaces*. Submitted.

Chapter 4

F. Valls Mascaró, M. T. M. Koper, and M. J. Rost, *Quantitative Study of Electrochemical Adsorption and Oxidation on Pt(111) and its Vicinal Surfaces*. Submitted.

Outlook

F. Valls Mascaró, M. T. M. Koper, and M. J. Rost, *Roughening of Pt(111) Vicinal Surfaces during Oxidation-Reduction Cycling*. In preparation.

Other publications

N. Fröhlich, J. Fernández-Vidal, F. Valls Mascaró, A. J. Shih, M. Luo, and M. T. M. Koper, *Electrochim. Acta*, **466**, 143035 (2023), *Effect of Trace Impurities in Perchloric Acid on Blank Voltammetry of Pt(111)*.

J. B. V. Mygind, F. Valls Mascaró, and M. J. Rost, *Arrhenius follows Frumkin to describe Atomic Diffusion Involved Peaks in Cyclic Voltammograms: the Reversible Place-Exchange Peak during the Electrochemical Oxidation on Pt(111)*. To be submitted.

Curriculum Vitae

Francesc Valls Mascaó was born on February 20th in Pollensa, Mallorca, Spain. There, he attended high school between 2007 and 2012, where he soon developed an interest for natural sciences. During this period, he also performed different extra-curricular activities, including playing basketball and performing as a percussionist in a band.

After graduating high school with “cum laude”, Francesc left the island of Mallorca and moved to Barcelona to start a bachelor in Chemistry at the University of Barcelona. However, this was a difficult choice, as he also had a high interest in physics and mathematics. During the summer holidays of 2016, he worked as a research assistant in the Soft Matter group from Prof. Dr. Francesc Sagués, where he had the first contact with scientific research whilst experimenting with microfluidics and colloidal systems. This led to developing his passion for physical chemistry, and hence the next academic year he undertook Computational Chemistry, Surface Science, and Electrochemistry as optional courses. Francesc found the later subject especially compelling, and upon receiving advice from Dr. Elisa Vallés, he decided to leave Spain with the ultimate goal of pursuing a scientific career.

Consequently, in 2017 Francesc joined a Master’s program in Electrochemistry at the University of Southampton (United Kingdom), which consisted of 9 months of intensive courses in electrochemistry, surface science, and engineering followed by a 3-month final project in a research laboratory of choice. Given his interest on fundamental studies for fuel cell technology, he decided to join the electroanalytical chemistry group of Dr. Guy Denuault, where he studied the Oxygen Reduction Reaction on Pt microelectrodes at the millisecond timescale under the daily supervision of Dr. Oliver Rodriguez. Upon completing this project in September 2018, he graduated with “Cum Laude” from the University of Southampton.

Just a few weeks later, Francesc moved to The Netherlands to pursue a PhD in electrochemistry and surface science under the supervision of Prof. Dr. Marc Koper and Dr. Marcel Rost at Leiden University. The project focused on studying the (in)stability of single-crystalline platinum electrodes under electrochemical conditions as well as the impact of surface structural changes on electrocatalysis. For this he used a home-built Electrochemical Scanning Tunneling Microscope, which allowed for the electrode surface characterization at the nanoscale. The interdisciplinary nature of the project provided him the opportunity to not only expand his knowledge in electrochemistry but also to develop a strong

background in nucleation and growth theory, fundamental thermodynamics, and dynamics of surface processes. He also learned Python programming, which is now part of his skillset to analyze both electrochemical data and topographic STM images.

In addition to this, Francesc had a side project in which he collaborated with other members from the Catalysis and Surface Chemistry (CASC) group to assess the effect of nitrate and sulphate trace impurities in perchloric acid on blank voltammetry of Pt(111). Moreover, he supervised a Master student in his final (one-year-long) project and two bachelor students for short term internships, on top of teaching practical courses of basic chemistry to first year students. Finally, he gave oral presentations on his research at numerous (inter)national conferences, including two invited talks (2021 and 2022) at the Annual meetings from the Dutch Association for Crystal Growth, an invited talk at the Annual meeting from The Electrochemical Society (2022), two contributed talks (2022 and 2023) at the Spring meeting from the German Physical Society, and one at the Annual meeting from the International Society of Electrochemistry (2023).

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Secondly, I want to thank all my colleagues in CASC - you made the workplace a truly enjoyable environment. Although I spent most of my doctorate operating the EC-STM alone, the catch-ups, mutual support, and exciting discussions with all of you motivated me to face the challenging EC-STM measurements with optimism. From the “old” group members I thank Matias and Stefan for supporting me since the first day in CASC, Ian McCrum for contributing with DFT in my first article, and Leon Jacobse for not only sharing your knowledge on the EC-STM setup but also for giving me permission to publish a few of your EC-STM images on Pt(111). To my former master student Bjarke, for the passion and dedication that you put in our project - it was a pleasure seeing you grow as a scientist.

From the “new” members, I thank Nicci and Julia for taking over a side project that I started during my first year, and shaping it into a beautiful article. Moreover, I am grateful to the colleagues with whom I shared most of this journey: Alisson, Cassia, Hassan, Nipon, Marleen, Onno, Saeid. You have always been there to offer your help and bring an uplifting attitude. To Rafaël and Sergi, for the wonderful mix of very professional scientific discussions and shared laughter at the most stupid jokes.

During these years in the Netherlands I had the pleasure to meet incredible people, also outside of the university, who have become close friends. Shout-out to David, for the countless laughs we have shared, our “philosophical” discussions about life at 90 degrees, and our sunrise-to-sunset hiking trips – my feet are still recovering from that.

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Last but not least, I am profoundly grateful for the unconditional support of my family. To my parents, Tomeu and Joana, who raised two very ambitious sons soon to graduate as doctorates - these accomplishments speak to the values that you imprinted in us. To my “little” brother Esteve, thank you for your help in programming and for our countless discussions related to our PhD journeys. To my grandpa, whose vitality and joy at 90 years of age is truly a source of inspiration. And to my cousins, aunts, uncles, and friends back home, thank you for all the enjoyable moments that allowed me to completely disconnect from work while in Mallorca.