Seminar

Rosa Arrigo

University of Salford, School of Science, Engineering and Environment, M5 2WT, Manchester, UK
r.arrigo@salford.ac.uk

Thursday, 31st October, 16:00 s.t.
Universität Innsbruck
Josef Möller Haus, Institut für Physikalische Chemie, Innrain 52C
Lecture Hall 1

The seminar will also be held as a Zoom Meeting
https://tuwien.zoom.us/j/66804848735?pwd=XgBflUSL7nYsJrJrUtiCzB0XJmfG9x.1
Meeting ID: 668 0484 8735
Password: 61VLgDZ1

Interfacial Chemistry in the Electrocatalytic Hydrogenation of CO_2 over C-Supported Cu/Fe-Based Systems

The direct electrocatalytic hydrogenation of CO_2 using renewable energy is a key technology for reducing fossil fuel dependence and electrifying the chemical industry while generating sustainable carbon-based fuels. Consequently, this reaction is the subject of extensive research. Copper (Cu) is a component of many electrocatalysts for the CO_2 reduction reaction (CO_2RR) due to its higher efficiency and selectivity towards CO_2 reduction products compared to the parasitic hydrogen evolution reaction (HER). However, the current electrocatalyst performances in terms of activity and stability are insufficient for commercial development, necessitating the design of superior electrocatalysts.

Understanding the molecular foundations of catalytic reactions aids in designing improved catalytic materials. This contribution focuses on understanding the dynamics at the reactive Cu interface using in situ and operando methods. I will present recent advancements in characterizing the CO_2 reduction reaction (CO_2RR) and our current understanding of its mechanism based on these methods.[1-2] The primary focus will be on soft X-ray spectroscopic techniques, specifically X-ray photoelectron and absorption spectroscopies. [1-5] These techniques are unique in catalytic science as they allow monitoring the evolution of the electronic structure of light elements (C, O, N) and metallic elements simultaneously, providing information on the nature of the metal in the electrode and the chemical speciation of adsorbates and components across the reactive interface. Additionally, I will discuss recent findings from our group regarding the morphological dynamics of Cu nanoparticles captured using in situ electron microscopy.

All interested colleagues are welcome to this seminar lecture
(45 min. presentation followed by discussion).

Günther Rupprechter
Director of Research

André Vogel
Coordinator

[1] J.-J. Velasco-Vélez, T. Jones, D. Gao, E. Carbonio, R. Arrigo, C.-J. Hsu, Y.-C. Huang, C.-L. Dong, J.-M. Chen, J.-F. Lee, P. Strasser, B. Roldan Cuenya, R. Schlögl, A. Knop-Gericke, C.-H. Chuang, The Role of the Copper Oxidation State in the Electrocatalytic Reduction of CO_2 into Valuable Hydrocarbons, *ACS Sustainable Chem. Eng.*, 7 (2019), 1485–1492.

[2] J.-J. Velasco-Vélez, C.-H. Chuang, D. Gao, Q. Zhu, D. Ivanov, H. S. Jeon, R. Arrigo, R. V. Mom, E. Stotz, H.-L. Wu, T. E. Jones, B. Roldan Cuenya, A. Knop-Gericke, R. Schlögl, On the activity/selectivity and phase stability of thermally grown copper oxides during the electrocatalytic reduction of CO_2, *ACS Catalysis*, 10 (2020) 11510-11518.

[3] J-J. Velasco-Velez, R.V. Mom, L.-E. Sandoval-Diaz, L. J. Falling, C.-H. Chuang, D. Gao, T. E. Jones, Q. Zhu, R. Arrigo, B. Roldan Cuenya, A. Knop-Gericke, T. Lunkenbein, R. Schlögl, Revealing the Active Phase of Copper during the Electroreduction of CO_2 in Aqueous Electrolyte by Correlating In Situ X-ray Spectroscopy and In Situ Electron Microscopy, *ACS Energy Lett*., 5 (2020), 2106–2111.

[4] R. Arrigo, R. Blume, A. Large, J.-J. Velesco-Velez, M., Haevecker, A. Knop-Gericke, G. Held, Dynamics over a Cu-graphite electrode during the gas-phase CO_2 reduction investigated by APXPS, *Faraday Discuss.*, 236 (2022) 126-140.

[5] D. Gianolio, M.D. Higham, M.G. Quesne, M. Aramini, R. Xu, A.I. Large, G. Held, J.-J. Velasco-Vélez, M. Haevecker, A. Knop-Gericke, C. Genovese, C. Ampelli, M. Erwin Schuster, S. Perathoner, G. Centi, C. R. A. Catlow, R. Arrigo, Interfacial Chemistry in the Electrocatalytic Hydrogenation of CO2 over C-Supported Cu-Based Systems, *ACS Catal.*, 13 (2023) 5876–5895.