

EPFL Valais/Wallis SEMINAR

22. 05. 2023, 14:00 - 14:30, EPFL Valais/Wallis in Sion, 4th floor, Emosson Room

Operando transient X-ray spectroscopy to determine the structure of the true catalytic active site.

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Recent developments in synchrotron radiation facilities and X-ray optics have further expanded the X-ray analytical toolbox for operando studies. These X-ray tools allow to follow the structure of the catalytic active site in action with high time-resolution and include X-ray absorption and emission spectroscopy, diffraction and total scattering. One of these tools, quick scanning X-ray absorption spectroscopy (with sub second time-resolution) in combination with transient experimentation provides a unique platform for determining the nature of the true catalytic active site and the rate limiting steps of a reaction.

In this talk, I will briefly present state-of-the-art in quick scanning X-ray absorption spectroscopy (XAS) and how this was leveraged to provide new insights into the dynamically changing structure of the catalytic active site under operating conditions: the oxygen evolution reaction over Co/Fe-based materials [1] as promising alternatives for IrO₂, and the ammonia assisted selective catalytic reduction of NO_x over Cu-chabazite (a small pore-size zeolite).

References:

- [1] E. Fabbri, M. Nachtegaal, T. Binninger, X. Cheng, B.-J. Kim, J. Durst, F. Bozza, T. Graule, L. Wiles, M. Pertoso, N. Danilovic, K.E. Ayers, T.J.Schmidt. Dynamic surface self-reconstruction is the key of highly active perovskite nano-electrocatalysts for water splitting. (2017) *Nature Materials*, 16, 925-931.
- [2] A. Marberger, A.W. Petrov, P. Steiger, M. Elsener, O. Kröcher, M. Nachtegaal*, D. Ferri*. 'Time-resolved copper speciation during selective catalytic reduction of NO on Cu-SSZ-13.' (2018) *Nature Catalysis* 1, 221-227.* Corresponding authors



CV: Maarten Nachtegaal

Maarten Nachtegaal is heading the center for operando studies in chemistry at the Paul Scherrer Institute (Switzerland). The operando groups operate and further develop two beamlines for operando chemistry research at the Swiss Light Source; the SuperXAS beamline for (pump-probe) X-ray absorption and emission spectroscopy and the Debye beamline for combined X-ray absorption spectroscopy, diffraction and total scattering experiments. Maarten earned his M.Sc. degree in geochemistry from Utrecht University (the Netherlands) a Ph.D. in environmental chemistry at the University of Delaware (USA) followed by a postdoctoral position at the ETH in Zürich (Switzerland). Since taking up his current position in 2005, the focus of his research is on heterogeneous/photo/electro-catalysis for C1 and C2+ chemistry and gas after treatment, primarily employing transient X-ray techniques under operando conditions to determine the structure of the true catalytic active site.

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