Breathing Pt nanoparticle imaged using in situ BCDI

Clément Atlan, Corentin Chatelier, Isaac Martens, Maxime Dupraz, Steven Leake, Marie-Ingrid Richard, Arnaud Viola, Frédéric Maillard

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Breathing Pt nanoparticle imaged using *in situ* BCDI

C. Atlan[1, 2, 3], C. Chatelier[1, 2], I. Martens[2], M. Dupraz[1, 2], S. Leake[2], M.-I. Richard[1, 2], A. Viola[3], F. Maillard[3]

[1] *Université Grenoble Alpes, CEA Grenoble, IRIG, MEM, NRS, 17 rue des Martyrs, F-38000 Grenoble, France.* mrichard@esrf.fr
[2] *ESRF - The European Synchrotron, 71 Avenue des Martyrs, F-38000 Grenoble, France.* leake@esrf.fr
[3] *Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, Grenoble INP, LEPMI, 38000 Grenoble, France.* frederic.maillard@grenoble-inp.fr

The relationship between surface strain and the rate of a (electro-)catalytic reaction was unveiled by Hammer and Nørskov using density functional theory (DFT) calculations [1,2]. They proposed that the rate of the sluggish oxygen reduction reaction (ORR) would be enhanced on Pt-based catalysts binding *OH species *ca*. 0.10 - 0.15 eV more weakly than Pt(111), [1, 2] later experimentally verified using a Pt_3Ni(111)-skin surface.[3] Nevertheless these predictions did not translate to Pt-based nanocatalysts, in part because these feature present multiple catalytic sites with a range of binding energies. Also, DFT calculations consider catalytic surfaces in vacuum, *i.e.* in the absence of water molecules and electric field. Hence, an *in situ* picture of how strain is distributed on Pt-based surfaces is still lacking.

In this contribution, we took benefit of recent advances in Bragg Coherent Diffraction Imaging (BCDI) [4, 5] and of the fourth generation Extremely Brilliant Source of the European Synchrotron (ESRF-EBS, Grenoble, France) to map strain over Pt nanoparticles in electrochemical environment. Our results reveal that strain is heterogeneously distributed between highly- and weakly-coordinated surface atoms, and propagates from the surface to the bulk of the Pt nanoparticle as (bi)sulphates anions adsorb on the surface.

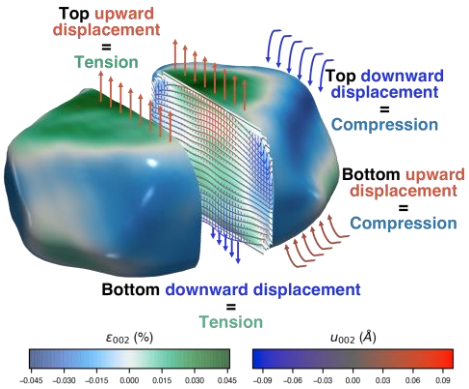

Figure 1: Representation of the strain distribution observed on a Pt nanoparticle under potential control. 0.05 M H_2SO_4.

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