Raphaël CHATTOT

Postdoctoral Fellow

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Research Interests

My research focuses on the structure-catalytic activity-stability relationships of low platinum-group metals based nanomaterials for the oxygen electrocatalysis in energy conversion and storage systems. Especially, I investigate on the emergence of desirable and stable electrocatalytic properties in acidic medium from structural disorder at the nanoscale.

Education

2014–2017 **Ph.D. Thesis in Electrocatalysis**, *University of Grenoble-Alpes*, Grenoble (38), France.
'Surface Distortion and Electrocatalysis : Structure-Activity Relationships for the Oxygen Reduction Reaction on PtNi/C Nanocatalysts'

2011–2014 **Master's Degree**, *Grenoble Institute of Technology, School of Physics, Electronics and Materials (PHELMA)*, Grenoble (38).
Electrochemistry and Process for Energy and Environment speciality. Magna Cum Laude

Research Experience

2018 – Ongoing **Post-Doctoral Position**, *European Synchrotron Radiation Facility (ESRF) and the Laboratory of Electrochemistry and Physico-chemistry of Materials and Interfaces (LEPMI)*, Grenoble, France.
'X-Rays Operando Studies of Oxygen Electrocatalysis on Structurally-Defective Nanocatalysts using Reduced Platinum-Group Metals Mass'

2016 **3 Months Student Exchange**, *TUB*, Berlin, Germany.
'Synthesis and Characterization of Preferetially-Shaped Bimetallic Nanoparticles for the Oxygen Reduction Reaction'

2014 **6 Months Degree Project**, *French Alternative Energies and Atomic Energy Commission (CEA)*, Grenoble (38), France.
'Investigations on Degradation Heterogeneities Within Proton-Exchange Membrane Fuel Cell Stacks.'

2013 **19 Weeks Internship**, *Paul Scherrer Institut (PSI)*, Villigen, Switzerland.
'Investigations on Gas Diffusivity in Fuel Cell membranes.'

Teaching/Administrative Experience

2014–2017 **Undergraduate Instructor**, *Grenoble Institute of Technology*, Grenoble (38), France.
Supervision of practical work and in charge of tutorial classes at the master's level.

Research Skills

Microscopy : Operator for TEM (JEOL 2010), STEM (JEOL JEM 2100F).

Analysis : Operator for (S)TEM/X-EDS, AAS (PinAAcle 900F PerkinElmer).

X-Ray Diffraction : Operator for ESRF ID31 high energy beamline (local contact since 2018) ; Beamline alignment, setup and measurement with various *ex situ* or *operando* techniques (WAXS, (GI)SAXS, XRR, CTRs etc.)

Electrochemical Systems : Catalytic ink formulation, MEA manufacturing and characterization, PEMFC single-cell and stack test bench operation, (LabVIEW), proposition of mitigation strategies, Rotating Disk Electrode (RDE) experiments (AUTOLAB, Nova),(BioLogic, EC-Lab).

Synthesis : Various nanomaterials with controlled nanoparticle shape and chemical composition

Metrics : 26 papers published in international peer-reviewed journals ; 530+ citations ; *h*-index = 13 (Scopus 13/07/2020).

Other Skills

IT : Microsoft Office suite, Origin, COMSOL, SolidWorks.

Programming : C++, Matlab, Python

Languages : French : mother tongue, English : proficient (B2 level based on Toefl IBT), Spanish : school notions

Driving : Driving licence (car and motorbike), motorboat.

Selected Publications

— **R. Chattot**, O. Le Bacq, V. Beermann, S. Kühl, J. Herranz, S. Henning, L. Kühn, T. Asset, L. Guétaz, G. Renou, J. Drnec, P. Bordet, A. Pasturel, A. Eychmüller, T. J. Schmidt, P. Strasser, L. Dubau, and F. Maillard, 'Surface distortion as a unifying concept and descriptor in oxygen reduction reaction electrocatalysis', *Nature Materials*, vol. 17, pp. 827-833, **2018**

— **R. Chattot** I. Martens, Marion Scohy, Juan Herranz, J. Drnec, Frédéric Maillard and Laetitia Dubau 'Disclosing Pt-Bimetallic Alloy Nanoparticle Surface Lattice Distortion with Electrochemical Probes', *ACS Energy Letters*, vol. 5, no. 1, pp. 162-169, **2020**.

— **R. Chattot**, T. Asset, P. Bordet, J. Drnec, L. Dubau and F. Maillard, 'Beyond Strain and Ligand Effects : Microstrain-Induced Enhancement of the Oxygen Reduction Reaction Kinetics on Various PtNi/C Nanostructures', *ACS Catal*, vol. 7, no. 1, pp. 398–408, **2017**

— **R. Chattot**, T. Asset, J. Drnec, P. Bordet, J. Nelayah, L. Dubau, and F. Maillard, 'Atomic-Scale Snapshots of the Formation and Growth of Hollow PtNi/C Nanocatalysts', *Nano Letters*, vol. 17, no. 4, pp. 2447–2453, **2017**.

Publications

— V. Gatard, D. De Masi, **R. Chattot**, I. Mustieles Marin, J. M. Asensio Revert, P-F. Fazzini, T. Encinas, V. Martin, S. Faure, J. Deseure, J. Carrey, B. Chaudret and M. Chatenet 'FeNi3 and Ni-Based Nanoparticles as Electrocatalysts for Magnetically Enhanced Alkaline Water Electrolysis', *Electrocatalysis*, Accepted, **2020**.

— S. Abbou, **R. Chattot**, V. Martin, F. Claudel, L. Solà-Hernandez, C. Beauger, L. Dubau and F. Maillard 'Manipulating the Corrosion Resistance of SnO2 Aerogels Trough Doping for Efficient and Durable Oxygen Evolution Reaction Electrocatalysis in Acidic Media', *ACS Catalysis*, vol. 10 no. 13, pp. 7283-7294, **2020**.

— C. Gommes, **R. Chattot** and J. Drnec 'Stochastic models of dense or hollow nanoparticles and their scattering properties', *Journal of Applied Crystallography*, Accepted, **2020**.

— L. Duclos, **R. Chattot**, L. Dubau, P. X. Thivel, G. Mandil, V. Laforest, M. Bolloli, R. Vincent and L. Svecova 'Closing the loop : Life cycle assessment and optimization of a PEMFC platinum-based catalyst recycling process', *Green Chemistry*, vol. 22, no. 6, pp. 1919-1933, **2020**.

— J. Fichtner, S. Watzele, B. Garlyyev, R. M. Kluge, F. Haimerl, H. A. El-Sayed, W-J. Li, F. Maillard, L. Dubau, **R. Chattot**, J. Michalička, J. M. Macak, W. Wang, D. Wang, T. Gigl, C. Hugenschmidt and A. S. Bandarenka 'Tailoring the Oxygen Reduction Activity of Pt Nanoparticles through Surface Defects : A Simple Top-Down Approach', *ACS Catalysis*, vol. 10, no. 5, pp. 3131-3142, **2020**.

— **R. Chattot** I. Martens, Marion Scohy, Juan Herranz, J. Drnec, Frédéric Maillard and Laetitia Dubau 'Disclosing Pt-Bimetallic Alloy Nanoparticle Surface Lattice Distortion with Electrochemical Probes', *ACS Energy Letters*, vol. 5, no. 1, pp. 162-169, **2020**.

— I. Martens, **R. Chattot**, M. Rasola, M.V. Blanco, V. Honkimäki, D. Bizzotto, D.P. Wilkinson, and J. Drnec, 'Probing the dynamics of platinum surface oxides in fuel cell catalyst layers using in situ x-ray diffraction', *ACS Applied Energy Materials*, vol. 2, no. 11, pp. 7772-7780, **2019**.

— I. Martens, A. Vamvakeros, **R. Chattot**, M.V. Blanco, M. Rasola, J. Pusa, S.D.M Jacques, D. Bizzotto, D.P. Wilkinson, B. Ruffmann, S. Heidemann, V. Honkimäki and J. Drnec, 'X-ray transparent proton-exchange membrane fuel cell design for in situ wide and small angle scattering tomography', *Journal of Power Sources*, vol. 437, no. 15, Article number 226906, **2019**.

— T. Asset, C. Gommes, J. Drnec, P. Bordet, **R. Chattot**, I. Martens, J. Nelayah, N. Job, F. Maillard and L. Dubau, 'Disentangling the Degradation Pathways of Highly Defective PtNi/C Nanostructures – An Operando Wide and Small Angle X-Ray Scattering Study', *ACS Catalysis*, vol. 9, no. 1, pp. 160-167, **2019**.

— **R. Chattot**, O. Le Bacq, V. Beermann, S. Kühl, J. Herranz, S. Henning, L. Kühn, T. Asset, L. Guétaz, G. Renou, J. Drnec, P. Bordet, A. Pasturel, A. Eychmüller, T. J. Schmidt, P. Strasser, L. Dubau, and F. Maillard, 'Surface distortion as a unifying concept and descriptor in oxygen reduction reaction electrocatalysis', *Nature Materials*, vol. 17, pp. 827-833, **2018**.

— T. Asset, **R. Chattot**, M. Fontana, B. Mercier-Guyon, N. Job, L. Dubau and F. Maillard, 'A Review on Recent Developments and Prospects for the Oxygen Reduction Reaction on Hollow Pt-alloy Nanoparticles', *ChemPhysChem*, vol. 19, no. 13 pp. 1552-1567, **2018**.

— T. Asset, N. Job, Y. Busby, A. Crisci, V. Martin, V. Stergiopoulos, C. Bonnaud, A. Seyrov, P. Atanassov, **R. Chattot**, L. Dubau and F. Maillard, 'Porous Hollow PtNi/C Electrocatalysts : Carbon Support Considerations To Meet Performance and Stability Requirements', *ACS Catalysis*, vol. 8, pp. 893-903, **2018**.

— T. Asset, **R. Chattot**, F. Maillard, L. Dubau, Y. Ahmad, N. Batisse, M. Dubois, K. Guérin, F. Labbe, R. Metkemeijer, S. Berthon-Fabry and M. Chatenet 'Activity and durability of platinum-based electrocatalysts supported on bare or fluorinated nanostructured carbon substrates', *Journal of the electrochemical Society*, vol. 165, no. 6 pp. F3346-F3358, **2018**.

— T. Asset, **R. Chattot**, O. Le Bacq, A. Pasturel, J. Drnec, P. Bordet, J. Nelayah, L. Dubau and F. Maillard, 'Porous Hollow PtNi/C Nanoparticles and Their Many Facets', *ECS Trans.*, vol. 80, no. 8, pp. 731-741, **2017**.

— T. Asset, **R. Chattot**, J. Drnec, P. Bordet, N. Job, F. Maillard and L. Dubau, 'Elucidating the Mechanisms Driving the Ageing of Porous Hollow PtNi/C Nanoparticles by the Means of COads Striping', *ACS Applied Materials and Interfaces*, vol. 9, pp. 25298-25307, **2017**.

— M. Lions, J.-B. Tommasino, **R. Chattot**, B. Abeykoon, N. Guillou, T. Devic, A. Demessence, L. Cardenas, F. Maillard and A. Fateeva, 'Insights Into the Mechanism of Electrocatalysis of the Oxygen Reduction Reaction by a Porphyrinic Metal Organic Framework', *Chemical Communications*, vol. 53, no. 48, pp. 6496-6499, **2017**.

— **R. Chattot**, T. Asset, J. Drnec, P. Bordet, J. Nelayah, L. Dubau, and F. Maillard, 'Atomic-Scale Snapshots of the Formation and Growth of Hollow PtNi/C Nanocatalysts', *Nano Letters*, vol. 17, no. 4, pp. 2447–2453, **2017**.

— L. Dubau, J. Nelayah, T. Asset, **R. Chattot** and F. Maillard, 'Implemeting Structural Disorder as a Promising Direction for Improving the Stability of PtNi/C Nanoparticles', *ACS Catalysis*, vol. 7, pp. 3072-3081, **2017**.

— O. Le Bacq, A. Pasturel, **R. Chattot**, B. Previdello, J. Nelayah, T. Asset, L. Dubau, and F. Maillard, 'Effect of Atomic Vacancies on the Structure and the Electrocatalytic Activity of Pt-rich/C Nanoparticles : A Combined Experimental and Density Functional Theory Study' *ChemCatChem*, vol. 9, no. 12, pp. 2324–2338, **2017**.

— **R. Chattot**, T. Asset, P. Bordet, J. Drnec, L. Dubau and F. Maillard, 'Beyond Strain and Ligand Effects : Microstrain-Induced Enhancement of the Oxygen Reduction Reaction Kinetics on Various PtNi/C Nanostructures', *ACS Catal*, vol. 7, no. 1, pp. 398–408, **2017**.

— G. Cognard, G. Ozouf, C. Beauger, G. Berthomé, D. Riassetto, L. Dubau, **R. Chattot**, M. Chatenet and F. Maillard, 'Benefits and Limitations of Pt Nanoparticles Supported on Highly Porous Antimony-Doped Tin Dioxide Aerogel as Alternative Cathode Material for Proton-Exchange Membrane Fuel Cells', *Applied Catalysis B : Environmental*, vol. 201, pp. 381-390, **2016**.

— T. Asset,**R. Chattot**, J. Nelayah, N. Job, L. Dubau and F. Maillard, 'Structure-Activity Relationships for the Oxygen Reduction Reaction in Porous Hollow PtNi/C Nanoparticles', *ChemElectroChem*, vol. 3, pp. 1591–1600, **2016**.

— L.Dubau, S. Moldovan, O.Ersen, J. Nelayah, P. Bordet, J. Drnec, T. Asset, **R. Chattot** and F. Maillard, 'Defects do Catalysis : CO Monolayer Oxidation and Oxygen Reduction Reaction on Hollow PtNi/C Nanoparticles', *ACS Catalysis*, vol.6, pp 4673-4684, **2016**

— L. Dubau, T. Asset, **R. Chattot**, C. Bonnaud, V. Vanpene, J. Nelayah and F. Maillard, 'Tuning the Performance and the Stability of Porous Hollow PtNi/C Nanostructures for the Oxygen Reduction Reaction', *ACS Catalysis*, vol. 5, pp. 5333–5341, **2016**.

— **R. Chattot** and S. Escribano, 'Ageing studies of a PEM Fuel Cell stack developed for reformate fuel operation in μCHP units : Development of an accelerated degradation procedure.' *International Journal of Hydrogen Energy*, vol. 40, pp. 5367–5374, **2015**.

— Z. Zhang, **R. Chattot**, L. Bonorand, K. Jetsrisuparb, Y. Buchmüller, A. Wokaun, and L. Gubler, 'Mass spectrometry to quantify and compare the gas barrier properties of radiation grafted membranes and Nafion®.' *Journal of Membrane Science*, vol. 472, pp. 55–66, Dec. **2014**.