A toolbox to study precious metal nano- catalysts: surfactant free synthesis, characterization and catalytic activity

Quinson, J.; Simonsen, Søren Bredmose; Kuhn, Luise Theil; Kacenauskaite, L. ; Inaba, M.; Swane, A. A. ; Kirkensgaard, J. J. K.; Jensen, K. Ø. M.; Oezaslan, M.; Kunz, S.; Vosch, T.; Arenz, M.

Published in:
Book of Abstracts Sustain 2017

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

A toolbox to study precious metal nano- catalysts: surfactant free synthesis, characterization and catalytic activity

J. Quinson*[1], L. Kacenauskaite[1], M. Inaba[1], A. A. Swane[1],S. B. Simonsen[2], L. Theil Kuhn[2], J. J. K. Kirkensgaard[3], K.Ø.M Jensen[1], M. Oezaslan[4], S. Kunz[5], T. Vosch[1] and M. Arenz*[1,6]

1: Nano-Science Center, University of Copenhagen, Universitetsparken 5, 2100 Copenhagen Ø, Denmark
2: Department of Energy Conversion and Storage, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark
3: Niels Bohr Institute, University of Copenhagen, Universitetsparken 5, 2100 Copenhagen Ø, Denmark
4: School of Mathematics and Science, Department of Chemistry, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg, Germany
5: Institute of Applied and Physical Chemistry, University of Bremen, Leobenerstraße, 28359 Bremen, Germany
6: Department of Chemistry and Biochemistry, University of Bern, Freiestrasse 3 CH-3012 Bern, Switzerland
*Corresponding authors email: jonathan.quinson@chem.ku.dk, matthias.arenz@dcb.unibe.ch

To develop an efficient catalyst for energy-related reactions (e.g. the oxygen reduction reaction (ORR) taking place in fuel cells), a careful control on every preparation steps is fundamental. The **synthesis** route, the **physical properties** of the obtained **nanoparticle catalyst** (e.g. composition of the catalyst, size, etc.) and further **processing and formulation** (e.g. nanoparticle loading on support, nature of the support, 'ink' formulation, etc.) can strongly influence the **catalytic performances** (e.g. maximum activity, stability, selectivity, etc.). To optimize a catalyst, it is necessary to **systematically control** and **systematically study** the effect of these different parameters.

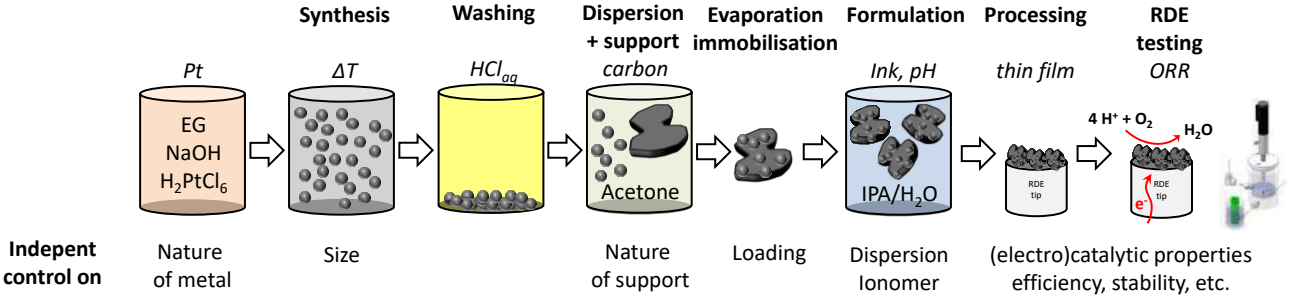

Fig. 1. Scheme of the steps in the toolbox approach to systematically study platinum catalysts for the ORR

Performing systematic studies is challenging with commercial catalysts since not all properties can be tuned independently. A **toolbox approach**[1] has been develop and shown over the years to be suitable to perform systematic studies and propose optimization strategies of platinum catalysts for the ORR.[2]

In this presentation, recent findings and development are highlighted regarding (1) the synthesis of precious metal nanoparticles (e.g. Pt) in particular regarding **size control** and developing **green synthesis** approaches[3]. (2) An overview of the **different characterization** techniques used and how they complement each other is given (e.g. Transmission electron microscopy, X-ray absorption spectroscopy, small angle X-ray scattering, and pair distribution function analysis). (3) Further **development** of the toolbox are highlighted and how a **transfer of knowledge** is/could be performed to other areas of electrocatalysis (e.g. for the oxygen evolution reaction performed in electrolyzers), of catalysis (e.g. for chemical production) or other fields of research (e.g. environmental science) is presented.

References.

1. J. Speder, L. Altmann, M. Roefzaad, M. Baumer, J. J. K. Kirkensgaard, K. Mortensen and M. Arenz, *Physical Chemistry Chemical Physics*, 2013, **15**, 3602-3608.
2. J. Speder, A. Zana and M. Arenz, *Catalysis Today*, 2016, **262**, 82-89.
3.L. Kacenauskaite, J. Quinson, H. Schultz, J. J. K. Kirkensgaard, S. Kunz, T. Vosch and M. Arenz, *ChemNanoMat*, 2017, **2**, 89-93.