



Thin Films of Pt and Pt-Gd as Model Catalysts for Oxygen Electroreduction

Zamburlini, Eleonora; Pedersen, Christoffer Mølleskov; Malacrida, Paolo; Escribano, Maria Escudero; Stephens, Ifan; Chorkendorff, Ib

Published in:
Book of Abstracts. DTU's Sustain Conference 2015

Publication date:
2015

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

[Link back to DTU Orbit](#)

Citation (APA):
Zamburlini, E., Pedersen, C. M., Malacrida, P., Escribano, M. E., Stephens, I., & Chorkendorff, I. (2015). Thin Films of Pt and Pt-Gd as Model Catalysts for Oxygen Electroreduction. In *Book of Abstracts. DTU's Sustain Conference 2015* Article E-39 Technical University of Denmark.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Thin Films of Pt and Pt-Gd as Model Catalysts for Oxygen Electroreduction

Eleonora Zamburlini, Christoffer Mølleskov Pedersen, Paolo Malacrida, Maria Escudero Escribano, Ifan Stephens, Ib Chorkendorff

CINF, Department of Physics, Technical University of Denmark, 2800 Kgs. Lyngby,

Eleza@fysik.dtu.dk

In order to enable the widespread production of fuel cells, the load of platinum in the cathode catalysts must be reduced and the activity must be improved. One way to do so is to fabricate thin films of platinum alloyed with other materials, such as non-precious metals and rare earths. [1] [2] [3]

We know from previous studies that sputter-cleaned, polycrystalline Pt₅Gd shows a five-fold increase in ORR activity [4], relative to Pt at 0.9 V in 0.1 M HClO₄, and it is highly stable. [4]

In comparison to those earlier studies on bulk samples, working with thin films will allow a high degree of control over the catalyst composition and thickness, so that we can determine the optimal alloy for high stability and activity.

Herein we present first a preliminary study of the strain in as prepared pure Pt thin film, induced by the deposition process. The structure have been analysed by X-ray diffraction (XRD), in the attempt to link the microstrain and the differences in crystallites to the electrochemical activity towards the ORR.

Furthermore, we will show the fabrication and characterisation of Pt₅Gd alloy thin films, produced via physical sputtering in ultra-high vacuum.

Rotating disk measurements were performed, and the resulting electrochemical activities have been compared with the ones from bulk extended surfaces of polycrystalline platinum alloys.

X-ray photoelectron spectroscopy and XRD were used to investigate the structure and composition before and after electrochemical measurements.

Results show a 3-fold improvement in activity of the thin film Pt₅Gd catalysts compared to the bulk sample, and the physical characterization highlights the formation of an oxygen free alloy, with structure and lattice parameters similar to the polycrystalline Pt₅Gd.

1. H. A. Gasteiger, Shyam S. Kocha, Bhaskar Sompalli, Frederick T. Wagner. *Appl. Catal. B* **2005**, 56, 9.
2. J. Greeley, I. E. L. Stephens, A. S. Bondarenko, T. P. Johansson, H. A. Hansen, T. F. Jaramillo, J. Rossmeisl, I. Chorkendorff & J. K. Nørskov *Nature Chem.* **2009**, 1, 552.
3. I. E.S. Stephens, Alexander S. Bondarenko, Ulrik Grønbjerg, Jan Rossmeisl and Ib Chorkendorff *Energy Environ. Sci.* **2012**, 5, 6744
4. M.Escudero Escribano, A. Verdager-Casadevall, P. Malacrida, U. Grønbjerg, B.P. Knudsen, A.K. Jepsen, J. Rossmeisl, I.E.Stephens, I. Chorkendorff *J Am Chem Soc.* **2012**;134(40):16476-9