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

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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 Pt_5Gd shows a five-fold increase in ORR activity [4], relative to Pt at 0.9 V in 0.1 M $HClO_4$, 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 Pt_5Gd 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 Pt_5Gd 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 Pt_5Gd.

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