Ordered Porous Electrodes by Design for Electrocatalysis

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The performance of electrocatalytic reactions is closely tied to the electrode design and the stability of the electrode's composition. One area of particular interest for understanding and optimizing these properties is for the oxygen reduction reaction (ORR). This catalytic process is a limiting reaction in polymer electrolyte membrane (PEM) fuel cells. Significant improvements have been made in the design of the platinum catalyst layers in the last few years. However, further work is required in order to optimize the use of platinum in these electrodes and to improve their operational stability on a time scale required for PEM fuel cells. We have developed a new platform for evaluating and optimizing the catalytic activity of platinum electrodes for ORR and other electrocatalytic processes. We prepared nanostructured porous platinum electrodes with a tunable pore size and thickness. These regular electrodes were prepared by electrodepositing platinum within a sacrificial template self-assembled from spherical polymer particles. The regularity of these electrodes provides a simple means to fine-tune the electrochemical surface area of these structures and to assess the stability of the platinum after prolonged periods of electrocatalysis. In addition, these structures can be further adapted to make supported platinum electrodes for ORR. This presentation discusses the recent results from our studies on these ordered porous platinum and supported platinum electrodes with the goal of further optimizing the catalytic activity of these layers for use in PEM fuel cells.