Formic Acid Electrooxidation on Cr-Supported Platinum Thin Film Catalyst

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In this study, the formic acid electrooxidation reaction was studied on a platinum thin film catalyst obtained by deposition on chromium support (Pt/Cr). In an attempt to reduce the proneness of Pt to poisoning species i.e. CO and improve the catalytic performance of Pt/Cr at low potentials in the formic oxidation reaction, the as-prepared catalyst was modified using controlled thermal treatment. The influence of thermal treatment on the electrode surface morphology was monitored using an atomic force microscope (AFM). Thus obtained catalyst was electrochemically characterized with cyclic voltammetry and oxidation of CO monolayer, while the performance of the catalyst was tested in a formic acid oxidation reaction. The improved activity on annealed Pt/Cr system is a consequence of the surface reconstruction of Pt film with predominant (111) orientation. Compared to other facets, the (111) facet selectively favors direct HCOOH oxidation, avoiding CO_{ad} poisoning at low potentials. Moreover, the Pt (111) facets offer improved stability of the catalyst compared to the as-prepared polycrystalline film. Finally, the Cr substrate also experiences improved stability after annealing, presumably due to the formation of a protective oxide layer. Thus, with the successful choice of the supporting material and annealing temperature, we were able to create a thin film catalyst with improved activity, selectivity and stability, in contrast with commonly observed activity-stability tradeoff in catalysis.

Keywords: Pt thin films; Cr support; thermal treatment; electrooxidation; formic acid

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