Electrochemical characterization and stability
of Ag$_x$Pt$_{1-x}$/Pt(111) surface alloys

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Abstract

As part of an extensive study of the performance of structurally well-defined Ag$_x$Pt$_{1-x}$/Pt(111) monolayer surface alloys in the O$_2$ electro-reduction we have systematically investigated the electrochemical properties and the stability of these electrodes in 0.5 M H$_2$SO$_4$ under mass controlled conditions in a flow cell set-up, varying the surface Ag content over a wide range. The surface alloys were prepared and structurally characterized on an atomic scale by scanning tunneling microscopy (STM) under UHV conditions, a transfer system allowed electrochemical measurements without intermediate contact to air. Base cyclic voltammetry (BCV) measurements showed distinct changes in the hydrogen and (bi)sulfate sorption behavior of the surface alloys with increasing Ag surface content. The electrochemical stability of the electrode surfaces was tested by BCV in 0.5 M sulfuric acid supporting electrolyte with a stepwise increase of the potential limit up to 0.95 V (vs. RHE). BCVs as well as STM measurements revealed that surface alloys with Ag contents up to 50% are stable in the electrochemical environment under these conditions, while for higher surface Ag contents dissolution of Ag sets in. The modifications in sorption behavior and stability are compared with recent findings for adsorption on similar surfaces under UHV conditions and related calculations, and discussed in a coherent picture.

Keywords: Corrosion, bimetallic electrode, surface alloy, adsorption, STM,

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