Performance of titanium oxynitrides in the electrocatalytic oxygen evolution reaction

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Abstract

Titanium oxynitrides were synthesized, characterized and tested towards with respect to their activity for the oxygen evolution reaction. Materials of different nitridation levels were fabricated via thermal treatment of titanium oxide with gaseous ammonia, varying the reaction temperatures and the ammonia flow rates. The resulting materials were characterized by X-ray diffraction, elemental carbon-hydrogen-nitrogen analysis, and X-ray photoelectron spectroscopy, yielding information about bulk crystallinity, chemical composition, and surface species present, respectively. The synthesized catalysts, which covered a wide range of oxygen-nitrogen ratios, show increasing oxidation current densities at about 1.2 V with a peak maximum at 1.7 V. This current does not result, however, from O₂ evolution, as indicated by online mass spectrometry measurements (differential electrochemical mass spectrometry). Increasing nitride contents are found to increase this oxidation current significantly, without improvement of the O₂-evolution activity. The nitride level dependent faradaic oxidation current around 1.7 V is attributed to an irreversible surface oxidation of the nitride sites, resulting in an oxidized material which is essentially inactive towards water electrolysis in the applied potential window.

Keywords: Electrocatalysis, O₂ evolution, Surface Oxidation, Titania, Nitridation

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