Borohydride Oxidation Reaction mechanism on nickel electrodes

Alexandr G. Oshchepkov†‡*, Guillaume Braesch†§, Gholamreza Rostamikia⊥, Gaël Maranzana∥, Antoine Bonnefont#, Michael J. Janik⊥, Elena R. Savinova†, Marian Chatenet§*

† Institut de Chimie et Procédés pour l’Energie, l’Environnement et la Santé, UMR 7515 CNRS-Univ. Strasbourg, 67087 Strasbourg Cedex, France
‡ Boreskov Institute of Catalysis, 630090 Novosibirsk, Russia
§ Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, Grenoble INP, LEPMI, 38000 Grenoble, France
∥ Univ. Lorraine, CNRS, LEMTA, UMR 7563, 54504 Vandoeuvre Les Nancy, France
⊥ Dept. of Chemical Engineering, Pennsylvania State Univ., University Park, PA, 16802, USA
# Institut de Chimie de Strasbourg, UMR 7177 CNRS-Univ. Strasbourg, 67070 Strasbourg, France

Marian.Chatenet@grenoble-inp.fr

Direct Borohydride Fuel Cells (DBFCs) could power portable and mobile devices owing to their high theoretical specific energy. The Borohydride Oxidation Reaction in principle occurs at very low potential (-1.24 V vs NHE, pH = 14) and produces 8 electrons per BH4-. However, these promises are not fulfilled on Pt and Pd, which are still the benchmarks for the BOR 1, because they promote fast hydrogen evolution reaction (HER), which does not enable oxidation currents below 0 V vs RHE. As such, the advantages of the DBFC over the PEMFC remain limited with such electrocatalysts. Nickel-based electrocatalysts appear promising, since they are stable in alkaline conditions and nickel state of surface can be tailored to limit or on the opposite promote the hydrogen reactions 2,3.

This presentation demonstrates that, indeed, nickel electrodes can be efficient for the BOR, in both rotating disk electrode setup and unit direct borohydride fuel cell 4. The BOR at Ni is also investigated in differential electrochemical mass spectrometry and Fourier-Transform infra-red spectroscopy. Based on these experimental findings and DFT calculations, a tentative mechanism of the BOR at nickel surfaces is proposed.

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