

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'Énergie, l'Environnement et la Santé, UMR 7515 CNRS-Univ. Strasbourg, 67087 Strasbourg Cedex, France

[‡] Borskov 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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