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Advantages and drawbacks of (alkaline) direct borohydride fuel cells

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Alkaline fuel cells start to compete with their acidic counterparts owing to the recent development of performant anion-exchange membranes, the possibility to use non-platinum electrocatalysts at their electrodes and their propensity to be directly fed with liquid fuels. In particular, fuels of the borohydride family (sodium borohydride, ammonia borane, hydrazine borane) have been demonstrated recently in unit cells [1,2]. However, their practical performances, notably in terms of cell voltage, efficiency and power, still fail to meet the theoretical promises, and even the practical ones derived from 3-electrode cell measurements [3].
Based on mechanistic studies of the borohydride oxidation reaction using coupled physicochemical techniques (Fourier Transform IR spectroscopy: FTIR, differential electrochemical mass spectrometry: DEMS), the reasons of the discrepancies between theory and practice will be explained. Special emphasis will be made on hydrogen escape, electrocatalyst poisoning by reaction intermediates, mass-transport (of the reactants and reaction intermediates) [4] and durability of the electrocatalysts [5,6]. As a result, a strategy to design optimized electrodes will be introduced.

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Marian Chatenet obtained a PhD in Electrochemistry (Grenoble-INP, 2000). After a post-doctorate (University of Minnesota), he became associate professor (2002) and professor (2011) in Grenoble-INP to study electrocatalysis and activity/durability of low-temperature fuel cells/electrolyzers. Best young scientist in Electrochemistry (French Chemical Society, 2009), he received the Oronzio and Niccolò De Nora Foundation Prize on Applied Electrochemistry (International Society of Electrochemistry, 2010), and the Electrocatalysis Distinguished Merit Award (Springer-Nature, 2018). Co-chair the "Mobility Applications" axis of the Hydrogen Federation of CNRS and Editor for J. Power Sources, he published 180+ papers, 9 patent and 250+ (inter)national conferences (50+ invited).