# Non noble metal catalysts for electrochemical energy conversion and hydrogen storage schemes

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We review here our work on several electrochemical technologies with the potential of achieving performances-over-cost ratios suitable for large scale applications.

**1. Alkaline water electrolysis and fuel cells**. Electrolysers and hydrogen fuel cells with Proton Exchange Membranes are compact and have good performances; however, they are unsuitable for large scale applications since they use platinum group metal (PGM) catalysts. We show that comparable performances may be achieved with alkaline devices based on gas diffusion electrodes with non-PGM catalysts. In particular, a comparison with PEM devices was carried out considering: i) system design and requirements, ii) efficiency, iii) power density, iv) lifetime and reliability.

**2. H-storage**. Hydrogen is conveniently stored in, and retrieved from, borohydrides but the rate of hydrogen generation from $BH_4^-$ hydrolysis in practical devices should be controlled Our CoO based porous electrode outperforms the reference Pt/C catalyst (see fig. 1)

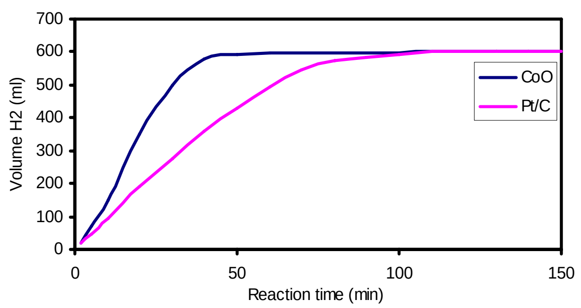


Fig. 1. Hydrolysis of borohydride using CoO and 10 wt% Pt/C

**3. Direct boro-hydride fuel cell**. Direct oxidation of $BH_4^-$ in a fuel cell is a challenging issue but this device has the potential of achieving superior power/energy densities at reduced cost. The incorporation of a gas diffusion electrode may simplify the design and enhance the performances in schemes using either aqueous electrolytes or an ion-conducting polymeric membrane.

**4. Metal hydride-air battery**. Primary and secondary Li-air batteries have the potential of displacing current alkaline, Li-ion and Zn-air batteries in low-power applications but major technological hurdles should be overcome to address safety, reliability and environmental concerns. We discuss the strong and weak points of our metal-hydride air battery which makes use of a gas diffusion electrode and has properties intermediate between a NiM-H and a Li-air battery.

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