



Hydrogen evolution on cathodes of Ni, Ni-Fe and Fe during alkaline water electrolysis

Iwona Flis-Kabulska^{1,2*} and Janusz Flis¹

¹*Institute of Physical Chemistry PAS, Kasprzaka 44/52, 01-224 Warszawa, Poland*

²*University of Cardinal Stefan Wyszyński, Wycickiego 1/3, 01-938 Warszawa, Poland*

Accepted for publication on 14th April 2015

The operating efficiency of nickel cathodes for hydrogen evolution reaction (HER) in KOH electrolytes decreases with time, however, cathodes can undergo reactivation by deposited iron. The reactivating effect of Fe was attributed to an increase in surface area or to preventing the formation of nickel hydride. To better understand the effect of Fe, in the present work cathodes of Ni without and with deposited Fe, and of Fe membranes were examined in 25% KOH at 80°C. Hydrogen permeation through the membranes was measured with the electrochemical technique.

After a prolonged cathodic polarization, Ni cathodes became more active for HER and underwent an activation following anodic polarisation. It was found that this effect was associated with the formation of deposits rich in Fe.

The amount of hydrogen absorbed in Fe membranes was determined by anodic polarization and simultaneous measurement of hydrogen permeation. It was found that electric charge of anodic oxidation was by over two orders of magnitude higher than the charge of desorbing hydrogen, and it increased with the pretreatment time. This was ascribed mainly to the oxidation of iron and of its corrosion products.

It was proposed that the activating effect of iron can be associated with the formation of highly reactive iron during cathodic reduction of oxide species (probably $\text{Fe}(\text{OH})_4^{2-}$). The activating effect of prior anodic polarisation can be due to the formation of large amounts of oxide species which can undergo the reduction to reactive iron.

Keywords: water electrolysis; nickel cathodes; iron deposits; anodic activation; hydrogen entry.