Electrochemically Synthesized Ni@reduced Graphene Oxide Composite Catalysts for Hydrogen Evolution in Alkaline Media – the Effects of Graphene Oxide Support

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Graphene-based materials and their role in electrocatalysis related to hydrogen production have been intensively investigated by many authors, often justified through a low price of such materials. In this study we used single-step electrodeposition/graphene oxide reduction route to prepare Ni@reduced-graphene-oxide composites for electrochemical hydrogen evolution reaction (HER). As the precursors for reduced graphene oxide, two different home-made graphene oxides were used. When compared to pure electrodeposited Ni, composite catalysts show improved catalytic activity which depends on Ni electrodeposition time in a volcano-type fashion. Using electrochemically prepared graphene oxide, HER overvoltage needed to reach 10 mA cm⁻² was reduced to only -97 mV, showing the improvement by roughly 200 mV when compared to pure electrodeposited Ni. It was concluded that structural disorder and surface oxidation of graphene-based materials are the key properties for reaching high HER activities of such prepared catalysts. Based on this observation, it was discussed whether it is economically justified to use high quality graphene oxide for the preparation of HER catalysts, as the price (production and commercial) of this material can be extremely high, often exceeding the price of platinum.

Keywords: reduced graphene oxide; Ni/rGO composite; platinum-free electrocatalyst; hydrogen production.

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