Comparison of electrodeposited composite coatings composed of commercial and synthesized MoO_2 embedded in Ni for hydrogen evolution reaction

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It is commonly known that the need for clean source of energy with the production and manufacturing costs being at the level of current solutions is getting greater. Among other candidates hydrogen shows great potential as substitution for fossil fuels because of its high energy content and possibility to be produced with zero emissions if the right method is chosen. Water electrolysis represents an excellent candidate for that role, but to achieve high efficiency concentrated hydroxide solutions serve as electrolytes in those systems. An advantage of the alkaline media is the possibility to use non-precious metals as catalysts, such as nickel. Ni is fairly stable in alkaline media and as an abundant element it is commonly used in alkaline water electrolysis as a catalyst substrate, or electrode itself. Transition metal oxides show excellent activity for hydrogen evolution reaction (HER) and have synergetic effect with Ni [1], based on that and the previous experience of our research group [2] this work is focused on catalysts composed of composite Ni-MoO_2 electrochemically deposited on different porous Ni substrates.

Firstly, the objective was to produce coatings consisted of MoO_2 with the smallest particles commercially available embedded in Ni. Ultrasound assisted electrodeposition showed no results due to the corrosive environment of the deposition bath, as well as the erosion effect of the particles (100nm) on the ultrasonic probe. Promising results were achieved when air bubbling toward the bottom of the cell was used as a method for keeping the non-metallic MoO_2 particles suspended in the solution. Considering the cost of the catalyst in order to try to reduce the production cost (and enhance the activity for HER) the second part of the research focuses on coatings with synthesized MoO_2, which has proven before to show better results [1]. Even though the electrodes coated with Ni-MoO_2 containing MoO_2 synthesized in our lab had less electrochemically active surface area (the substrate was Ni mesh that doesn`t offer as much surface area as Ni foam used as substrate in first part of research) it showed much better activity towards HER. Overpotential on current density of -500 mA cm^{-2} was -88 mV, being 30 mV lower than on Ni foam electrode coated with composite containing commercial MoO_2 particles which can be seen od Figure 1. In the production of this type of catalyst, the method for dispersing MoO_2 through the bulk of the solution was stirring with magnetic stirrer and circulating the electrolyte during the deposition. The future goal is to continue the work on finding the optimal conditions for preparing a coating with the same characteristics on Ni foam substrate which should have even higher activity towards HER.

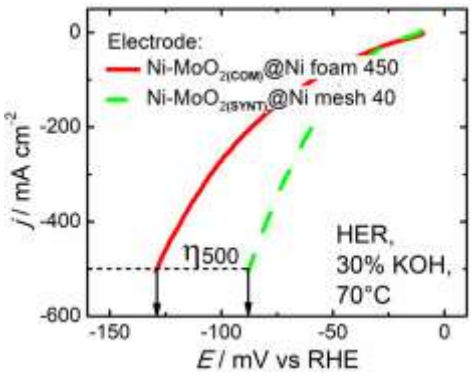

Figure 1. HER polarization curves recorded at porous electrodes coated with composite coatings based on commercial (COM) and synthesized (SYNT) MoO_2

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