Ni-Sn coated Ni foams – suitable cathodes for large-scale alkaline water electrolysis?

Jelena D. Gojgić[1], Aleksandar M. Petričević[1], Thomas Rauscher[2], Christian I. Bernäcker[2], Luka Pavko[3], Marjan Bele[3], Francisco Ruiz-Zepeda[3], Milutin Smiljanić[3], Nejc Hodnik[3], Mila N. Krstajić Pajić[1], Vladimir D. Jović[4]

[1]*University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia*

[2]*Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Branch Lab Dresden, Winterbergstraße 28, 01277 Dresden, Germany*

[3]*National Institute of Chemistry, Hajdrihova ulica 19, 1000 Ljubljana, Slovenia*

[4]*Retired from the University of Belgrade, Institute for Multidisciplinary Research, Kneza Višeslava 1, 11030 Belgrade, Serbia*

Driven by the continuously increasing demand for electricity, diminishing carbon-based energy resources, steadily increasing ecological concerns, the focus has shifted to finding clean and renewable solutions. Electrochemical energy conversion and storage systems have taken the spotlight in shaping a greener future, with hydrogen, obtained through electrolysis, emerging as a leading energy carrier candidate. The scalability and abundance of materials used in alkaline water electrolysis, alongside the maturity of this industrial process, make it a favoured pathway for hydrogen production powered by renewables.

Electrodeposition was firstly investigated through linear sweep voltammetry and controlled potential coulometry[1] techniques, in order to obtain high-performance Ni-Sn coated Ni foam. The objective was to achieve coatings of optimal composition to enable outstanding catalytic activity towards hydrogen evolution reaction, characterized by low overpotentials that are below – 100 mV at current density of – 1 A cm^{-2}, normalized per geometric area, in 1 M KOH. Since these electrodes showed promising results, the electrodeposition was further investigated in galvanostatic setting in order to determine the most favourable conditions, as this technique is better suited for industrial-scale plating. Ni-Sn coated Ni foams, deposited at specific constant deposition current density, were additionally tested in zero-gap flow electrolysers where they have shown good stability and low value of overvoltage, which is in alignment with criteria proposed by IRENA[2].

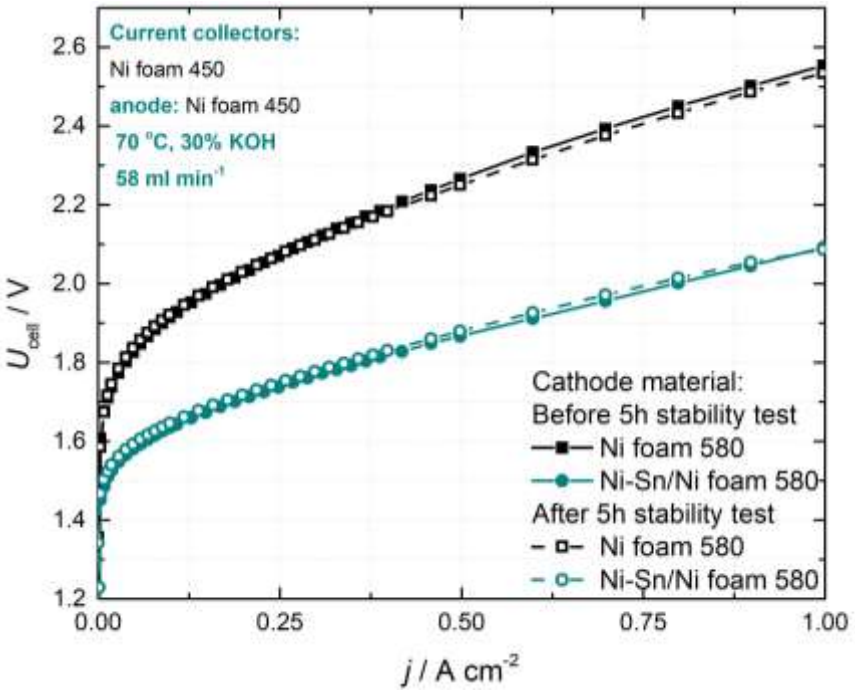

Figure 1. Cell voltage – current density dependency when two different cathodes are used – Ni-Sn coated one, and bare Ni foam

Acknowledgement: This work was supported by the Federal Ministry of Education and Research – Germany, through the WBC2019 call – project NOVATRODES 01DS21010, and by the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia (Contract No. 451-03-65/2024-03/200135).

References

1. J.D. Gojgić, A.M. Petričević, T. Rauscher, C.I. Bernäcker, T. Weißgärber, L. Pavko, R. Vasilić, M.N. Krstajić Pajić, V.D. Jović, *Appl. Catal. A Gen.* **663** (2023) https://doi.org/10.1016/j.apcata.2023.119312
2. IRENA (2020), Green Hydrogen Cost Reduction: Scaling up Electrolysers to Meet the 1.5°C Climate Goal, International Renewable Energy Agency, Abu Dhabi