COMBINATORIAL DESIGN OF NOVEL BIPOLAR PLATE COATINGS FOR PROTON EXCHANGE MEMBRANE ELECTROLYZERS (CODE-PEM)- EEA-RO-NO-2018-0502

Goal of the project

The CoDe-PEM project aims to contribute towards the development of affordable PEM electrolysis systems with the development of lower cost coating materials for bipolar plates and sinters. In order to lower the costs, a reduction in use of expensive materials and the introduction of new low(er) cost materials are key elements. In addition, new materials should allow for fast and low-cost manufacturing processes, such as stamping of BPP flow structures.

Short description of the project

Via an interdisciplinary partnership, the project aims to integrate research groups with complementary experience in materials development and hydrogen technologies of groups from the Institute of Renewable Energy from Politehnica University Timisoara (UPT) with the research groups New Energy Solutions and Corrosion and tribology, both within the institute of industry in SINTEF, see below.

In order to reach the goals of the project, the challenges related to the plate cost, corrosion, interfacial contact resistance (ICR) of the MEA/sinter/BPP stack and the materials durability will be addressed. This will be achieved by identifying optimal material compositions that avoids rapid performance degradation due to the formation of electrically resistive surface oxides, and that prevents contamination by potential dissolved ions from corrosion of the substrate (metal) plates.

Project implemented by

Politehnica Universitiy Timisoara, Romania
SINTEF Trondheim, Norway

Implementation period

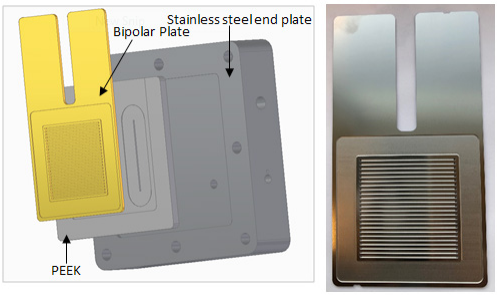
2019-2023

Main activities

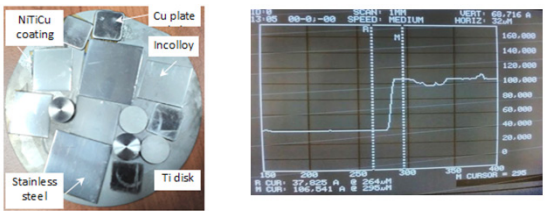
- Preparation of a database with potential materials systems for substrate-coating couples to be used for the fabrication BPP.
- Installation and upgrade of the combinatorial exploration system in UPT. A state of the art system is planned to be developed in UPT to allow the manufacture of compositional spreads out of several targets and with the possibility to grade libraries thickness.
- Preparation of the ex- and in-situ experimental set-up at SINTEF, including the test cell with online ICR monitoring.
- Ex situ- characterized libraries that will provide the information needed to tune up the combinatorial system and to adjust the composition range for the experiments.
- Optimized coating will results following the combinatorial - exploration – tests - manufacture - test iterative sequence.
- Ex situ and in situ characterized BPP that will provide further functional information for the optimization process

Results

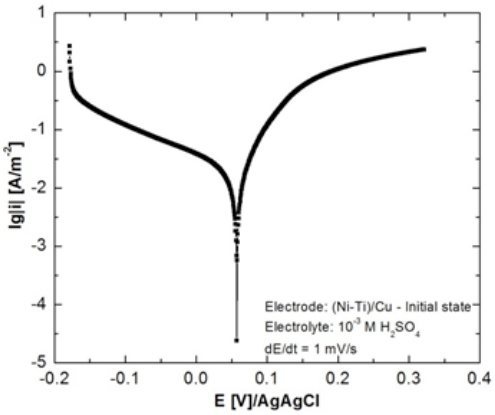
Finished design of electrolyzer test cell (left) Stainless steel BPP (right)

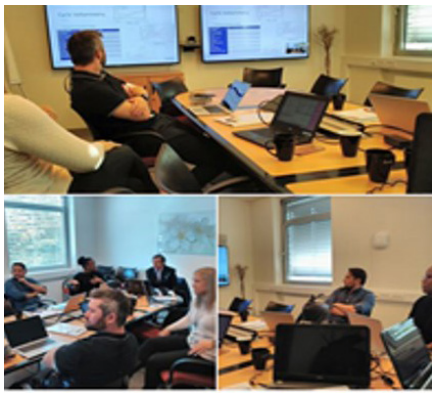


Different substrates with NiTiCu films deposited by magnetron sputtering (left) and the measurement of the film thickness (right)



Linear polarization curves (Tafel plots) on (Ni-Ti)/Cu electrode in H2SO4 10-3 M + 0.1 ppm F-1 at room temperature recorded at 1mV/s scan rate.





Partner's meeting in SINTEF

Applicability and transferability of the results

- The CoDe-PEM project will contribute to the Energy efficiency by focusing on identifying lower cost materials for electrolysers so that the cost of electrolyser systems can significantly be reduced.

Financed through/by

SEE Financial Mechanism (EEA Grants), 2014-2021

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Combinatorial exploration group
Fuel cells group
SINTEF:
New energy solutions group
Corrosion and tribology group

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