

Hydrogen from RES: pressurised
alkaline electrolyser with high
efficiency and wide operating
range

RESelyser
(278732)



Regine Reissner
DLR, Institute of Engineering
Thermodynamics
www.reselyser.eu

PROJECT OVERVIEW

- Call topic SP1-JTI-FCH.2010.2.1: Efficient alkaline electrolyzers
- Application area: Infrastructure Hydrogen production and distribution
- Start: 01/11/2011, end: 30/04/2015; project terminated
- Total budget: 2.89 Mio.€, FCH JU contribution: 1.48 Mio.€, regional support: 594,000 DKK from ForskEl program of Energinet.dk
- Consortium:



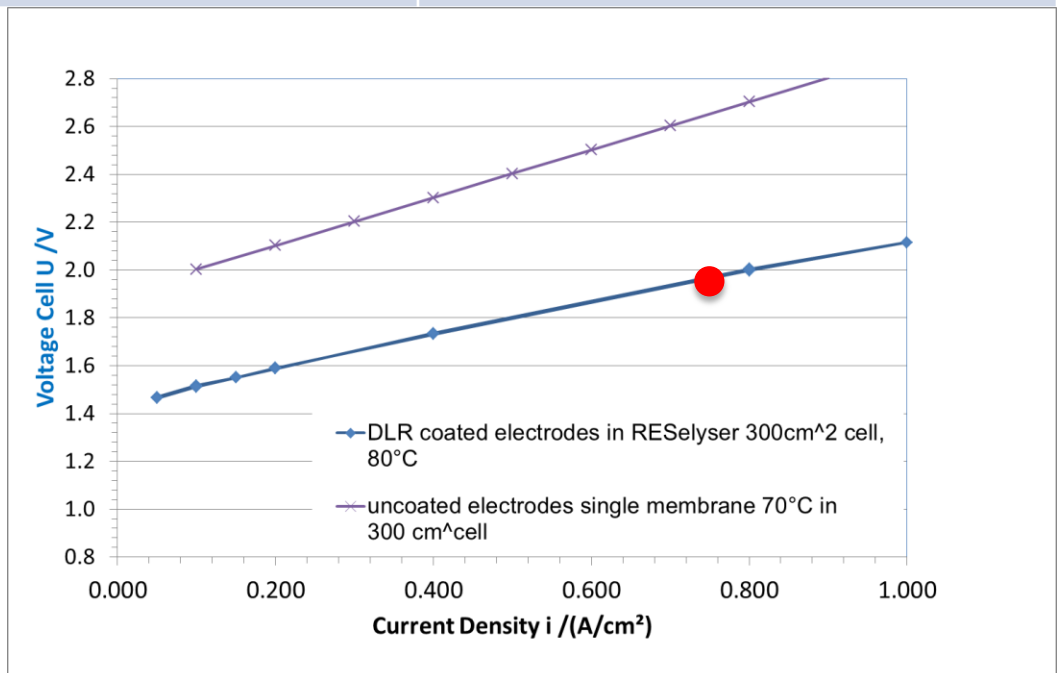
The project develops **high pressure, low cost** alkaline water electrolyzers that can be integrated with **renewable power sources** using

- an advanced membrane concept,
- highly efficient electrodes
- and a new cell concept

PROJECT TARGETS AND ACHIEVEMENTS

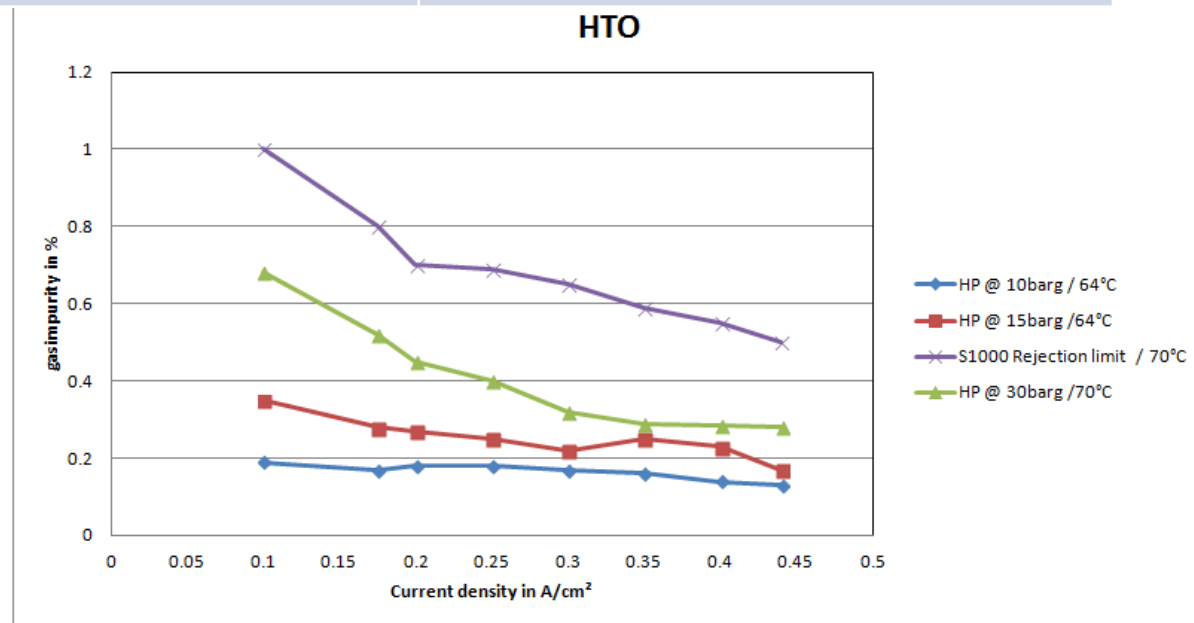
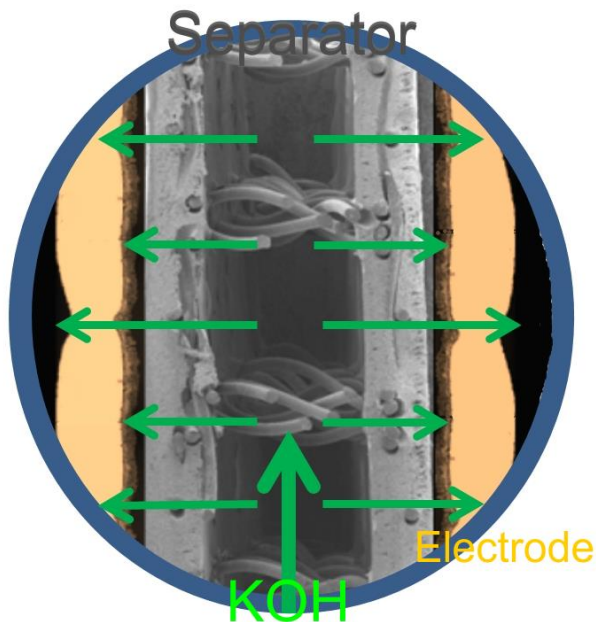
Programme objective/target	Project objective/target	Project achievements to-date = final achievements
AIP 2010: Efficiency @current density $0.75 \text{ A/cm}^2 > 80\%$ on HHV basis	Efficiency @current density $0.75 \text{ A/cm}^2 \eta > 80\%$ on HHV basis 300 cm^2 electrodes, low-cost materials	Total efficiency $\eta = 76\%$ on HHV basis at a current density of 0.75 A/cm^2 in a 300 cm^2 cell, 82% for smaller cell

- Highly efficient electrodes by VPS coating
- Low-cost materials: only Ni alloys



PROJECT TARGETS AND ACHIEVEMENTS

Programme objective	Project objective	Project achievements
Electrolyser system operation at high pressure 15MPa=150 bar with compression or 3 MPa=30 bar without compression	100-150 bar concept, 25 bar realisation	Tests up to 30 bar, subsequent compression considered in system concept



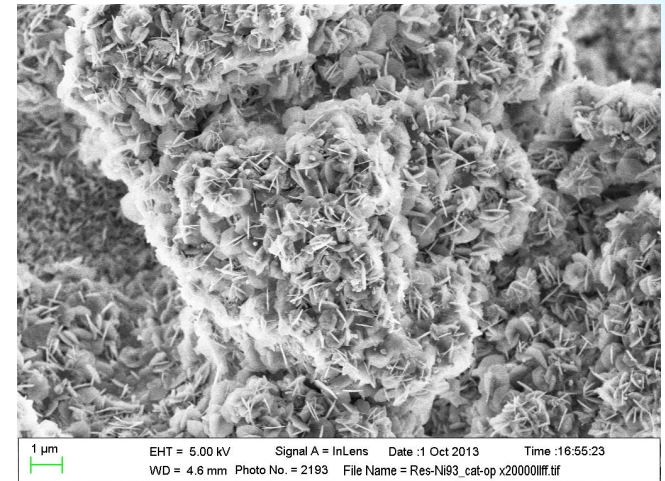
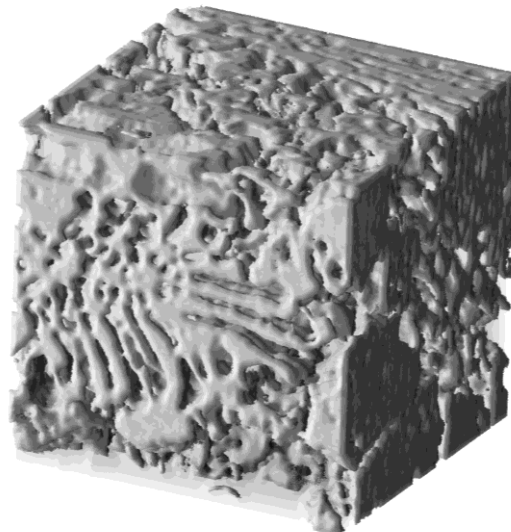
E-Bypass separator membrane to technical size

Improved gas quality: <40 ppm O₂ in H₂ single cell 5 bar, lower than SotA in 10 kW stack

PROJECT TARGETS AND ACHIEVEMENTS

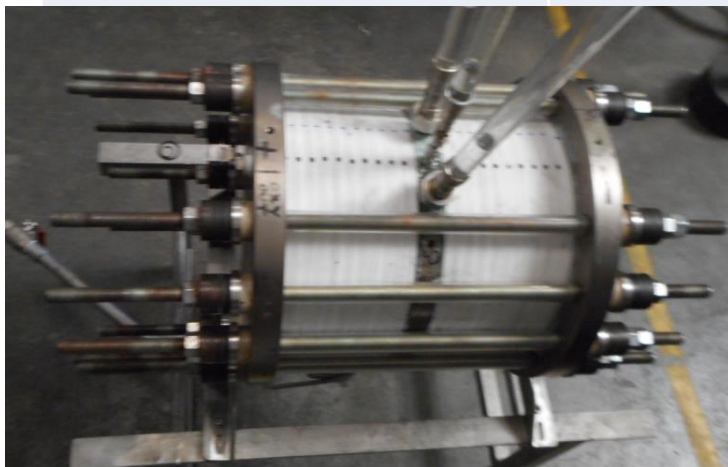
Programme objective	Project objective	Project achievements
Retention of >90% of initial efficiency over at least 1000 on/off switching cycles	Retention of >90% of initial efficiency over at least 1000 on/off switching cycles demonstrated with 10 kW electrolyser	Electrode potential 98% of initial efficiency over 1100 on/off switching cycles; higher degradation in stack

3D pore analysis and electrode degradation analysis to support the coating development



PROJECT TARGETS AND ACHIEVEMENTS

Programme objective	Project objective	Project achievements
AIP 2010: Power level stack exceeding 5kW	Power level stack 30 kW	Power level stack 10 kW range, operated up to 8 kW
AIP 2010: Modular system cost €1,000 per Nm ³ /h plant capacity for the stack and €3,000 per Nm ³ /h plant for a complete system	Modular system costs €3,000 per Nm ³ /h plant capacity for the complete system	Estimate 2,300 €/(Nm ³ /h) plant capacity stack costs S2500 running at 65 bar, 7K€/(Nm ³ /h) for a Hex. S1000 65bar _g reselyser system. Costs of electrolyser system for some application cases lower than state of the art



RISKS AND MITIGATION

- Lower power stack than originally planned because technical problems caused delays that could not be made up for during project time but higher pressure realised than originally planned
- System costs could not be reached but new technique with better performance has lower costs than state of the art in some applications. Further system simplification would be necessary

SYNERGIES WITH OTHER PROJECTS AND INITIATIVES

- Partner DTU received 594,000 DKK from ForskEl program of Energinet.dk
- There is no FCH JU/EU-funded projects precursor project
- Interactions:
 - Joint meetings with ELYGRID project
 - Participation in ELECTROHYPEM workshop
 - Partner Hydrogenics also coordinator of DON QUICHOTE
 - DLR also coordinator of INSIDE

HORIZONTAL ACTIVITIES

- Training activities: 1 master and 1 bachelor thesis, 2 high school student's projects
- Experience collected for future definition of standard tests

DISSEMINATION ACTIVITIES

- The project ideas and results were presented at 16 conferences or meetings of the hydrogen community by 7 posters, 12 oral presentations and 2 exhibitions.
- Publications in peer-reviewed journals in preparation
- Presentation at NOW GmbH - FCH-JU electrolysis day 2014
- 1 patent

EXPLOITATION PLAN/EXPECTED IMPACT

- Double layer membrane developed to technical size process. Licensing is discussed
- Electrode coating high efficiency with low cost materials demonstrated. Next step to transfer to commercial company.
- Experience and learnings from project can immediately be used for Hydrogenics' products

Thank you for your attention

For further details visit our project web site

www.reselyser.eu