The Institute of Technical Thermodynamics started developing various kinds of electrolysers for a large range of applications approx. in 1985. The main topics are the development of stabilized electrodes for applications with drastic load changes and high durability as well as the understanding of mechanisms and degradation effects.

**Unitized Regenerative Fuel Cells**

Unitized regenerative fuel cells (URFC) in combination with photovoltaic modules are attractive systems for space missions because they enable extended operation times and low weight. The URFC uses only one stack for both fuel cell and electrolysis mode. Different strategies can be adopted:
- Use of single layered electrodes with a bifunctional catalyst (IrO₂+Pt) (option 1)
- Use of separate electrodes for O₂ evolution (IrO₂) and consumption (Pt) (option 2)
- Use of a multi layered electrode with separate layers (option 3)

The MEAs were prepared with DLR dry powder spraying method.

**Electrolysis test stations** are operated at DLR capable of testing half cells and single cells to short stacks up to 100 cm² cell area. By linking the resulting ex situ analysis methods degradation processes are identified.

**Electrode Development for Alkaline Water Electrolysis and Cell Tests**

DLR has developed coatings for anodes and cathodes on the basis of Raney-nickel that are efficient, low-priced with long life. The coating is done by vacuum plasma spraying (VPS) on nickel sheets or nickel-plated steel sheets. Furthermore for these electrodes an excellent long-term stability during several years was demonstrated in intermittent operation using a solar power profile without potential control during off-times.

**FCH-JU-Project RESelyser**

The project RESelyser, coordinated by DLR, develops high pressure, highly efficient, low cost alkaline water electrolyzers that can be integrated with renewable energy power sources (RES) using an advanced membrane concept, highly efficient electrodes and a new cell design. A new separator membrane with internal electrolyte circulation and an adapted design of the cell to improve mass transfer, especially gas evacuation is investigated and demonstrated. Intermittent and varying load operation with RES will be addressed by improved electrode stability and a cell concept for increasing the gas purity of hydrogen and oxygen especially at low power and at high pressure operation. Also the system architecture will be optimized for intermittent operation of the electrolyser.

**Project partners:**

1. DLR, Institut fuer Technische Thermodynamik, D-70569 Stuttgart; 2. VITO NV, B-2400 Mol; 3. Hydrogenics Europe NV, B-2260 Oevel; 4. Risoe DTU, Technical University of Denmark

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