# INSIDE – In-situ Diagnostics in Water Electrolysers

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In this joint R&D project supported by the EU Fuel Cell and Hydrogen Joint Undertaking, an electrochemical in-situ diagnostics tool for the monitoring of locally resolved current densities in polymer electrolyte membrane fuel cells, is adapted to three different water electrolysis technologies. The developed tools allow correlating performance issues and ageing processes with local anomalies. The corresponding mechanisms are investigated with ex-situ analytics.

The patented segmented printed circuit board (PCB) for the monitoring of current density distributions in PEM based fuel cells is used and steadily improved at DLR. Applications are specific degradation mechanisms and optimisation of operation parameters. The real time technology allows, e. g., to observe and mitigate local deactivation of the fuel cell due to condensing water or irreversible local ageing. It has already been adapted for the use in Redox-Flow Battery systems and is ready for the next development step.

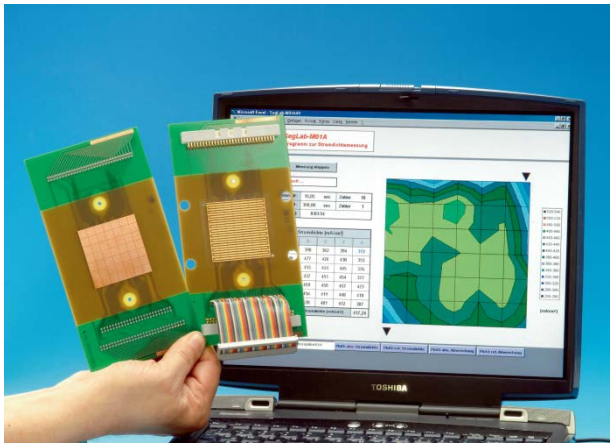

**Figure 1.** Segmented printed circuit boards for in-situ online-diagnostics in PEM fuel cells

In water electrolysis, the technological boundaries are different to that of fuel cells, but similarly, there is need for systematic optimisation by locally resolved in-situ analytics and, in particular for an on-line diagnostics tool. The challenges for the adaptation of the segmented board technology to chemical and physical environment are different for each of the three involved technologies:

- Alkaline water electrolysis
- Proton exchange membrane based water electrolysis
- Anion exchange membrane based water electrolysis

For each technology, pH and chemical ambience, pressure temperature, bubble formation, and typical range of current densities hold different requirements to layout and corrosion stability. The proof of concept has already been shown in PEM based electrolysis.

<u>Collaboration partners:</u>

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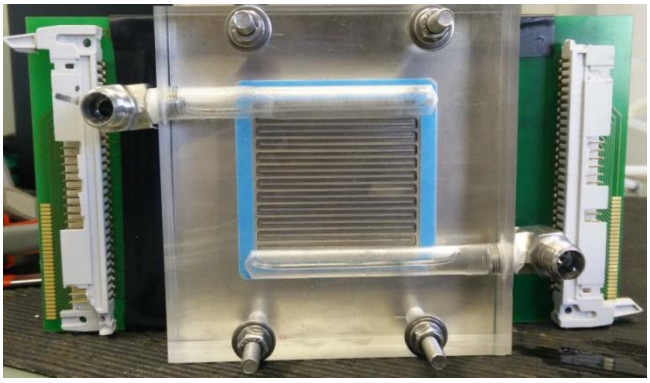
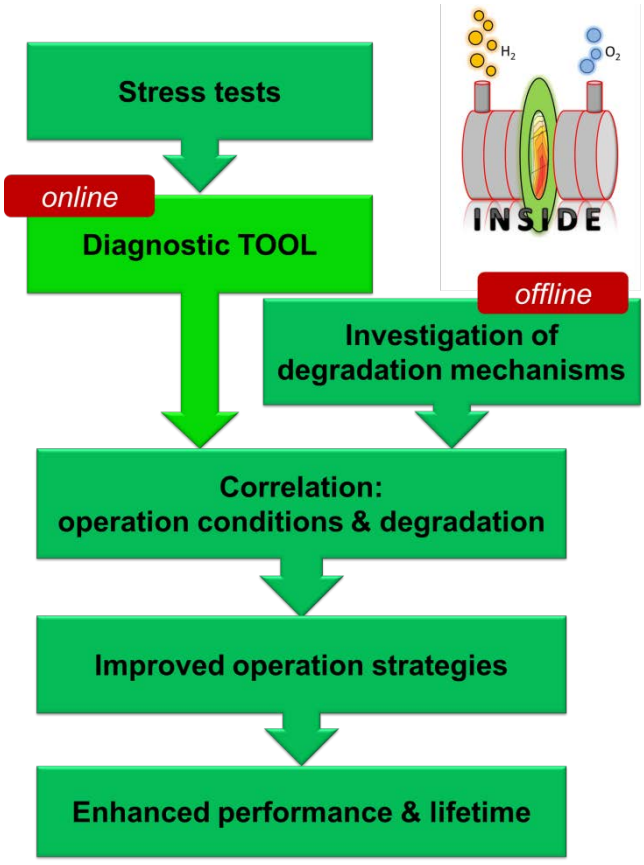


**Figure 2.** Successful integration of segmented PCB in PEMWE test cell with optical access

The long-term strategy for the utilisation of on-line in-situ diagnostics is to monitor performance and local anomalies during operation, and to correlate these with the operation parameters. Critical and poorly performing operation can be identified and, by adjusting operation modes, be prevented. Ex-situ characterisation helps to identify local deficiencies and ageing mechanisms. Additionally, systematical local deficiencies can be identified, that are not detectable with integrating methods.

The implementation of on-line diagnostic allows a more targeted and systematic optimisation of the three technologies. Both operation strategies for better performance and life time of existing systems, and design strategies for improved water electrolysers can be derived.




## Acknowledgement

This undertaking receives funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for Fuel Cell and Hydrogen Joint Technology Initiative under Grant No. 621237 (INSIDE).

European Commission

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