

# SOE technology on its way to the industry

Dr. Mihails Kusnezoff, Dr. Roland Weidl,  
Prof. Alexander Michaelis

## High efficiency with ceramic high-temperature electrolysis

"Green molecules" are an integral part of future climate neutrality. The efficient conversion of "green electrons" from renewable energies into "green hydrogen" takes place via electrolysis. The efficiency of this process increases with the operating temperature of the electrolyzer. The lowest energy consumption and highest degree of efficiency are achieved at operating temperatures of 650 to 800 °C (high-temperature electrolysis) with steam ( $H_2O$ ) and co-electrolysis ( $H_2O/CO_2$ ). For this purpose, ceramic cells (solid-oxide electrolysis (SOE) cells), planar stacks and modules developed at Fraunhofer IKTS have already proven themselves in demonstration projects worldwide.

## Challenges of serial production

At Fraunhofer IKTS, cell, stack and module production has been implemented on a prototype scale for years. However, scaling up to mass production poses a number of challenges: building a resilient supply chain, automating component manufacturing processes, developing, automating and integrating rapid quality control, and developing rapid manufacturing processes for speed-determining steps in the production process.



Fig. 1: High-temperature electrolysis stack for water vapor and co-electrolysis (operating temperature 750 to 830 °C).

These challenges have already been addressed in numerous development projects at Fraunhofer IKTS, albeit without practical implementation in a pilot production line.

## Approach to industrialization

The European and global demand for electrolyzers is immense. To meet this demand, a production capacity in the gigawatt range is necessary, giving crucial importance to a partnership with a potent industrial partner with market experience. For this reason, a strategic cooperation with thyssenkrupp nucera has been established to implement the technology developed at Fraunhofer IKTS on the global market.

The joint approach to industrialization consists of the short-term construction and operation of a pilot line for stack and module production at the institute's site in Arnstadt (Thuringia), where new manufacturing processes and innovative ideas for automating the production steps are tested before production is scaled up to the gigawatt range.



Fig. 2: Development of a stack automation system for the serial production of SOE stacks.

The realization of the pilot line will create local, German and European value chains in the field of automated cell and stack production. In addition, the activities strengthen Germany as an industrial location in one of the most important innovation areas of the future energy system.