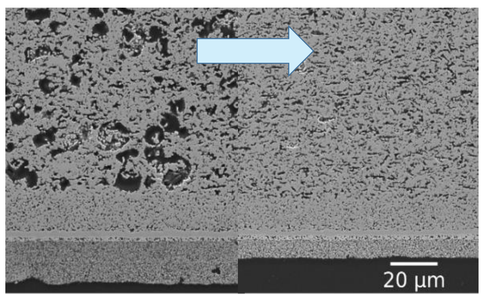
Reversible solid oxide Electrolyzer and Fuel cell for optimized Local Energy miX

Objectives

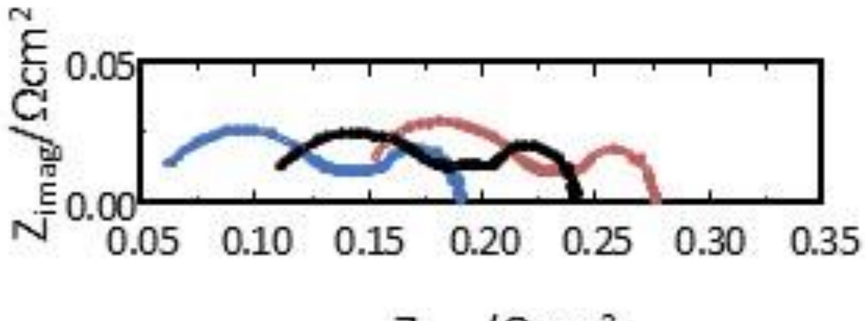
The REFLEX project aims at developing an innovative renewable energies storage solution, the “Smart Energy Hub”, based on reversible Solid Oxide Cell (rSOC) technology, able to operate either in electrolysis mode (SOEC) to store excess electricity to produce H_2, or in fuel cell mode (SOFC) when energy needs exceed local production, to produce electricity and heat again from H_2 or any other fuel locally available.
The challenging issue of achieving concomitantly high efficiency, high flexibility in operation and cost optimum is duly addressed through improvements of rSOC components (cells, stacks, power electronics, heat exchangers) and system, and the definition of advanced operation strategies.

Cells



Standardized cell performance evaluation at open circuit voltage (OCV) and targeted operating conditions of various microstructure modifications, i.e. fuel electrodes, oxygen electrodes and barrier layer, have been conducted.

In total more than 10 different microstructures and cell layouts have been produced and compared.



Cells which show initially high performance are further durability tested under reversible operating conditions. The cells were operated galvanostatically over 1000h with cycles made of 16 h in fuel cell and 8 h in electrolysis mode.

Stacks

Stack design has been optimized for rSOC operation. A minimization of the internal air pressure drop (by a factor of 2) and an improvement of the sealing resistance towards higher pressure could be achieved while maintaining the electro-chemical performance.

BoP components and system design

The operating points of the Smart Energy Hub have been defined with the support of modelling: 3 modes (SOEC, SOFC-H2 and SOFC-CH4), and 3 setpoints per mode (min, mean, max).
The electrical architecture has been defined to maximize the electrical efficiency. The electrical components have been selected, purchased/or manufactured. The thermal management components have been specified as well.
Various scenarios for the demonstration at Envipark have been defined, taking into account production and consumption profiles.

In-field test

An in-field demonstration will be performed at Envipark, in Italy, where the Smart Energy Hub will be coupled to local solar and mini-hydro renewable sources and will provide electricity and heat to the headquarters of the park. It will demonstrate, in a real environment, the high power-to-power round-trip efficiency of this technology and its flexibility in dynamic operation.
The preliminary works requested for the installation have started.

The REFLEX project – www.reflex-energy.eu
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