Numerical investigation of the effect of gas flow configuration on the performance of a solid oxide electrolyzer

High temperature electrolysis of water is an interesting process for the production of green hydrogen as it allows to reduce the electrical energy input compared to low temperature electrolysis processes while limiting the temperature requirements with respect to thermochemical processes. Among the high temperature electrolysis processes, solid oxide electrolysis is the most mature technology. The performance of solid oxide electrolys cells (SOECs) is affected by several factors, including the characteristics of the main cell components, the operating temperature, and the flow rate , flow configuration and composition of the gas feed.

The main reactions taking place at the cathode and anode of the cell are, respectively,

$$H_2O + 2e^- \rightleftharpoons H_2 + O^{2-} \quad (1)$$

$$O^{2-} \rightleftharpoons \frac{1}{2} O_2 + 2e^- \quad (2)$$

The present work is an experimental and modelling study of a planar SOEC, carried out with the main aim of investigating the effect of the gas flow configuration on the performance of the system.