

MATERIALS SCIENCE AND TECHNOLOGY

AMMIN - Joining and integration of Protonic ceramic electrolysis cells

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Context of the research activity	Design and processing of glass and ceramic materials, as well as surface engineering, to achieve improvements in all components present in a proton-conducting ceramic membrane device. Sinter-crystallisation of glass and ceramics, coupled with 3D printing technologies, will ensure the high quality, reliability, and scalability of the different components while improving their microstructures and features.
Objectives	Protonic ceramic electrolysis cell (PCEC) devices operate at considerably lower temperatures compared to other high-temperature electrolyzers, such as solid oxide electrolysis cells (SOECs), specifically 500-600 °C, compared to 700-850 °C for high-temperature electrolyzers, due to the lower activation energy for proton transport. The lower working temperature allows for more flexible material selection, as well as potentially improved durability. Additionally, nominally dry and pure hydrogen can be directly produced and even slightly pressurized in PCEC without further gas separation. Nowadays, studies related to PCECs have been confined to the lab scale, with only a few attempts to scale up this technology. A single repeating unit (SRU) and a stack of large-area PCEC cells remains a technological challenge, and the formulation of appropriate glass-based sealants to join ceramic cells and metallic interconnects is necessary to fulfil this task. This PhD thesis will focus on the design and processing of glass-based seals for the joining and integration of PCECs cells with metallic interconnects. The final aim is to assemble a single repeating unit and a 5-cell short stack. Specifically, the PhD candidate will study the glass-to-metal and glass-to-ceramic interfaces and will be involved in assessing and characterizing their mechanical properties, as well as processing different glass-sealing deposition techniques.
Skills and competencies for the development of the activity	Glass and Ceramic sintering, hydrogen technology.

