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Study of a glass-ceramic sealant over the stack lifetime

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ABSTRACT

1. Title: Study of a glass-ceramic sealant over the stack lifetime

2. Keywords (5 max)

High-Temperature Electrolysis, Seal, Glass-ceramic, Crystallization

3. Abstract (maximum 500 words):

The SOC electrolysis technology, used for dihydrogen production by steam electrolysis at high temperature, is based on a successive stack of single repeat units (SRU). Those are made of electrolysis cells and metallic interconnects, ensuring both the collection of oxygen and hydrogen and the electronic conduction between the different SRUs. In such complex systems, ensuring gas-tightness of this ceramic/metallic multilayer assembly fed with different gases is technically very challenging. The seals between interconnectors and interfaces must comply with very demanding specifications. In

In addition to sealing constraints, specific mechanical, thermomechanical and chemical properties are required for the material as well as sufficient electrical resistivity.

The high temperature characteristics of glass oxides and glass-ceramic seals make this type of material one of the few candidates suitable as sealants. Furthermore, the complex geometries of seals support the use of paste made of glass powder suspended in organic solvents. This way, the seal can be deposited easily and precisely on the interfaces to be sealed. A heat treatment is then applied to shape the material and ensure the formation of gas-tight interfaces between the stacks interfaces. During this thermal process, the material crystallizes resulting in a glass-ceramic. In order to control and maintain a proper seal, it is important to master the glass-ceramic microstructure as a function of time and temperature over the stack lifetime.

This paper presents the study and modelling of the material crystallization. Phases are first identified and evolution of crystals morphology as a function of temperature is characterized (SEM, XRD). Crystal surface fraction is quantified as a function of time and temperature by image analysis. Glass-ceramic crystallization kinetics are then modelled using the Johnson-Mehl-Avrami-Kolmogorov model. Finally, results are compared with data obtained from a seal having operated for several months. This allows us to obtain a better description of the seal microstructure evolution during the stack operation (time and temperature).