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Novel Glass-ceramic SOFC Sealants from Glass Powders and a Reactive Silicone Binder

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Abstract

The processing of sintered ceramics is often conditioned by the debinding step. The binders may determine some defects in the final product directly, by causing some gas evolution even at an advanced state of densification, due to incomplete decomposition at low temperature, or indirectly, by offering poor adhesion between particles, so that 'green' compacts may be easily damaged. The present investigation is aimed at exploring a novel concept for sintered glass-ceramics, based on the adoption of a silicone polymer as reacting binder, providing an abundant ceramic residue after firing. A glass belonging to the CaO-MgO-Al_2O_3-SiO_2 system, already studied as a sealant in solid oxide fuel cell (SOFC) planar stack design, was reproduced in form of 'silica-defective' variants, featuring a SiO_2 content, in the overall formulation, reduced up to 15 wt%. The overall silica content was recovered by mixing powders of the new glasses with the silicone: upon firing in air, the interaction between glass powders and polymer-derived silica led to glass-ceramics with the same assemblage than those formed by the reference glass and with a CTE of 9.5 x 10^{-6} K^{-1}. The new approach has been successfully applied to the manufacturing of glass-ceramic seals as joining materials for solid oxide cells.

Keywords

Glass-ceramic Sealant; XRD; Polymer-derived Ceramics

Introduction

Glass-ceramics offer distinctive advantages in the manufacturing of solid oxide fuel cells (SOFCs) and solid oxide electrolysis cells (SOECs), when applied as sealants between the metallic interconnect (typically Cr-containing ferritic stainless steel) and the electrolyte (typically yttria stabilized zirconia) [1,2,3].

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