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Bonding characteristics of glass seal/metallic interconnect for SOFC applications: Comparative study on chemical and mechanical properties of the interface

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Introduction:
Glass and glass-ceramics have been extensively used as seal material in planar solid oxide fuel cell (SOFC) stack. The main objective of the present work was to investigate the joining properties of a silicate based glass-ceramic seal material with two different ferritic stainless alloys as interconnect, i.e. SS430 and Crofer 22APU.

Steps:
(1) A glass was synthesized with the nominal composition of 30–50 mol%SiO2, 0–10 mol%B2O3, 5-15 mol% Al2O3, 25-50 mol% SrO, 0-25 mol% CaO, and 3 mol% (8.16 wt.%) Y2O3.
(2) Sandwich samples are joined and aged at 800 ºC in the furnace and glued between two steel beams.
(3) Typical microstructures of Metal/Glass-ceramic joints after aging for 100h in air at 800 ºC: low (left), high magnification (right).

Materials and methods:
(1) The advantages of the technique, stable crack growth, allows fracture energy and toughness of a material to be evaluated.
(2) The approach involves a new specimen geometry, in which a sandwich sample is glued onto a DCB instrument.
(3) Double cantilever beam (DCB) test. The method allows to measure the crack-growth resistance of these materials to be evaluated.

Fabrication of small sandwich samples of metal/glass/metal for macro-mechanical testing:
(1) Optical micrograph of Crofer22APU/glass-ceramic/Crofer22APU (left) and reduced elastic modulus map for the selected area.
(2) Typical microstructures of Metal/Glass-ceramic joints after aging for 100h in air at 800 ºC: low (left), high magnification (right).

Summary:
(1) A technique for evaluating the critical energy-release rate/fracture toughness of this glass-ceramic layer and stainless-steel metal strips is described.
(2) The approach involves a new specimen geometry, in which a sandwich sample is glued onto thicker steel beams.
(3) The advantages of the technique, stable crack growth, allows fracture energy and toughness of a designed joint materials to be evaluated.
(4) The fracture toughness for crack initiation was measured with a very good reproducibility.

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