Novel Glass-ceramics from Glass Powders and Reactive Silicone Binders

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Abstract

The processing of sintered glass-ceramics, i.e. material from the sintering of fine glass particles, with concurrent crystallization, is often conditioned by the debinding step. Typical carbonaceous polymeric binders, namely subjected to complete decomposition upon firing, may determine some defects in the final glass-ceramic directly, by causing some gas evolution continuing even at an advanced state of densification, or indirectly, by offering poor adhesion between particles (so that 'green' compact may be easily damaged). The present investigation is aimed at exploring a novel concept, based on the adoption of silicone polymers, providing an abundant ceramic residue after firing. Some glasses (belonging to the CaO-MgO-Al2O3-SiO2 and CaO-B2O3-SiO2 systems), normally yielding useful glass-ceramics by heat treatment, were reproduced in form of 'silica-defective' variants, featuring a SiO2 content, in the overall formulation, reduced up to 15 wt%. The overall silica content was recovered by mixing powders of the new glasses with silicone binders: 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 glasses. The new approach has been successfully applied to the manufacturing of glass-ceramic joints for SOFCs as well as of glass-ceramic scaffolds for tissue engineering

Keywords: glass, ceramics, additive manufacturing, silicones

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