PROJECT "THEORY AND APPLICATIONS OF SINTER-CRYSTALLIZATION" DN 19/7

# Glass-ceramics from glass powders and reactive silicone binders: from sealants to additive manufacturing

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**Abstract:** A target glass-ceramic system may be processed by means of a novel technique, relying on the reaction of glass powders with silicone polymers. Instead of the parent glass, a 'silica-defective variant' is considered. A fundamental feature is the fact that the silicone polymer act as binders for glass powders from room temperature up to the firing temperature, at which, operating in air, they convertinto silica. The interaction between 'silica-defective' glass powders and binder-derived silica allows for the recovery of the original stoichiometry. The overall process has important advantages when glass powders lead to glass-ceramics, by sinter-crystallization, after burn-out of organic binders. The shape of components may be lost simply by sliding of particles before the activation of viscous flow. Silicones, besides providing an extended binding action up to the maximum firing temperature, stabilize the shapes during sintering. Otherwise significant viscous flow of softened glass is prevented by the formation of a rigid silica skeleton, from the transformation of the silicone binder. After successful preliminary applications to glass-ceramic sealants for SOFC, we will present extension to glass-ceramic scaffolds, for tissue engineering applications, manufactured by application of advanced additive manufacturing technologies. We will show that reactions in nitrogen enable the transformation of silicone binders into silica and pyrolytic carbon, in turn leading, by reaction with glass powders, to novel glass-ceramic/C composites.