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Ultrafast and Energy-Efficient Crystallization of Glasses with Low Thermal Expansion

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Biography

I am a postdoctoral researcher at the Federal University of São Carlos (UFSCar), funded by FAPESP and under the supervision of Prof. Ana Candida Martins Rodrigues. My current research focuses on the ultrafast crystallization of glasses under electric fields using techniques such as Flash Crystallization and Ultrafast High-Temperature Sintering. Part of this work is being developed at the University of Trento, Italy, under the supervision of Prof. Vincenzo Maria Sglavo. I completed my PhD at the University of São Paulo (USP), where I optimized Flash Sintering for zirconia, hydroxyapatite, and hydroxyapatite-zirconia composites.

Abstract

Ultrafast High-Temperature Sintering (UHS) has been recently proposed for producing ceramics in a very short time. The used apparatus offers a sustainable alternative also for producing glass-ceramics. By enabling rapid heating to extremely high temperatures within seconds through the application of an intense electric current to a carbon felt containing the sample, it allows to significantly reduce energy consumption and production times compared to conventional methods. In this study, the technology was employed to promote rapid crystallization in bulk glass samples of the $\text{Li}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2$ system, demonstrating its effectiveness in controlling microstructure and tailoring material properties. Glass specimens were subjected to Joule heating within carbon felt electrodes under an argon atmosphere. Various electric currents were applied, resulting in distinct power outputs and temperature profiles, suitable to identify optimal conditions for efficient crystallization. The resulting glass-ceramics were analyzed for their crystalline phase composition, microstructure and thermal expansion behavior. The findings point out that higher power densities enhance crystallization efficiency and allow to control the crystallized fraction and thermal properties. Ultrafast crystallization emerges as a promising route for producing glass-ceramics with tailored properties and reduced environmental impact, supporting sustainable manufacturing practices in the glass industry.

