Contribution ID: **47** Type: **3. Oral presentation**

Fabrication of Al_2O_3 Ceramics via Vat Photopolymerization 3D printing and Ultrafast High-Temperature Sintering

Vat photopolymerization 3D printing has emerged as a promising additive manufacturing (AM) technology for producing high-precision ceramic components. However, long post-processing times remain a significant challenge for industrial implementation. To address this limitation, the present study systematically investigates the effects of Ultrafast High-Temperature Sintering (UHS) processing parameters on the densification and mechanical properties of vat-photopolymerization-printed alumina ceramics. A two-factor, two-level factorial experimental design with central point replication was employed, considering electric current (70–80 A) and isothermal dwell time (30–60 s) as the independent variables. Green bodies were fabricated using a commercial alumina slurry (LithaLox350). The UHS process was directly compared with conventional sintering performed at 1650 ℃ with a 2-hour dwell time. Comprehensive characterization included three-point flexural strength, Vickers microhardness, relative density, grain size distribution, and fracture toughness. The results obtained so far demonstrate that UHS enables rapid densification while promoting a refined microstructure, achieving relative densities above 95% and flexural strength values of up to 538.9 MPa. These findings highlight the potential of UHS as a viable post-processing route for accelerating the production of high-performance ceramic components fabricated by vat photopolymerization.

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

Journal of the European Ceramic Society (Elsevier)

Invitation letter for visa

No

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Session Classification: Ultra-fast High Temperature Sintering UHS

Track Classification: Group 3: Ultra-fast High Temperature Sintering UHS