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Performance Evaluation of 3D Printed ZrO_2 Ceramic Components by Nanoparticle Jetting™

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Abstract : Additive manufacturing has exerted a tremendous fascination on the development of the manufacturing and materials industry in the past three decades. Zirconia-based advanced ceramic has been poured substantial attention in the interest of structural and functional ceramics. As a novel material jetting process for selectively depositing nanoparticles, NanoParticle Jetting™ is capable of fabricating dense zirconia components with a high-detail surface, precisely controllable shrinkage, and remarkable mechanical properties. The presence of NPJ™ gave rise to a higher elevation regarding the printing process and printing accuracy. Emphasis is placed on the performance evaluation of NPJ™ printed ceramic components by which the physical, chemical, and mechanical properties are evaluated. The experimental results suggest the Y_2O_3-stabilized ZrO_2 boxes exhibit a high relative density of 99.5%, glossy surface of minimum 0.33 μm, general linear shrinkage factor of 17.47%, outstanding hardness and fracture toughness of 12.43±0.09 GPa and 7.52±0.34 MPa·$m^{1/2}$, comparable flexural strength of 699±104 MPa, and dense and homogeneous grain distribution of microstructure. This innovative NanoParticle Jetting system manifests an overwhelming potential in dental, medical, and electronic applications.

Keywords : nanoparticle jetting, ZrO_2 ceramic, materials jetting, performance evaluation
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