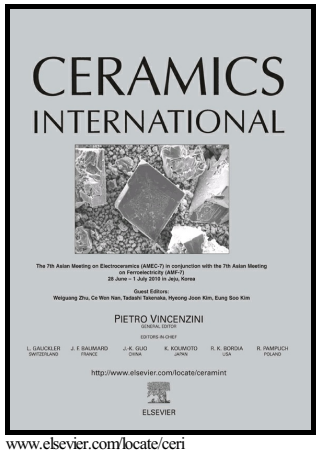

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Study on surface quality, precision and mechanical properties of 3D printed ZrO_2 ceramic components by laser scanning stereolithography

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Abstract: Zirconia (ZrO_2) ceramic bars with three different printing sizes were fabricated by a stereolithographic (SLA) 3D-printing process and subsequent sintering. An anisotropic character of the ceramics surface quality was observed. The surface roughness of the horizontal surface was below 0.41 μm, whereas it reached 1.07 μm along the fabrication direction on the vertical surface. The warpage and flatness were utilized to measure the dimensional accuracy of the 3D printed ZrO_2. Furthermore, it was evaluated that the warpage and flatness were below 40 μm and 27 μm, respectively, even if the printed size of ceramic bar reached 3mm×4mm×80mm. In addition, the flexural strength, the fracture toughness, the hardness and the density of ZrO_2 ceramics can reach to 1154 ± 182 MPa, 6.37 ± 0.25 MPa·$m^{1/2}$, 13.90 ± 0.62 GPa and up to 99.3%, respectively. Moreover, the effects of scanning paths and printing size on properties of the sintered ZrO_2 samples were analyzed. The anisotropic character of surface quality was related to the various scanning paths. The warpage and flatness of 3D printed ZrO_2 bars were apparently affected by the various printed sizes. Also, the effects of special microstructure on the mechanical properties of sintered ZrO_2 samples were investigated.

Keywords: 3D printing, ZrO_2 ceramic, Surface quality, Precision, Mechanical properties