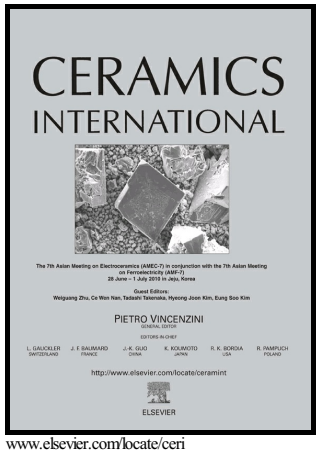

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Ultrasonic Vibration-Assisted Laser Engineering Net Shaping of ZrO_2-Al_2O_3 Bulk Parts: Effects on Crack Suppression, Microstructure, and Mechanical Properties

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Abstract

Laser additive manufactured zirconia-alumina ceramic (ZrO_2-Al_2O_3) parts demonstrate severe problems resulting from cracking and inhomogeneous material dispersion. To reduce these problems, we propose a novel ultrasonic vibration-assisted laser engineered net shaping (LENS) process for fabrication of bulk ZrO_2-Al_2O_3 parts. Results showed that the initiation of cracks and the crack propagation were suppressed in the parts fabricated by LENS process with ultrasonic vibration. For the parts fabricated without ultrasonic vibration, the sizes of cracks decreased with the increase of laser power. Scanning electron microscope analyses proved that the introduction of ultrasonic vibration was beneficial for grain refinement and uniform material dispersion. Due to the suppressed cracking, refined grains, and homogenized material dispersion, the parts fabricated with ultrasonic vibration demonstrated better mechanical properties (including higher microhardness, higher wear resistance, and better compressive properties), compared with the parts fabricated without