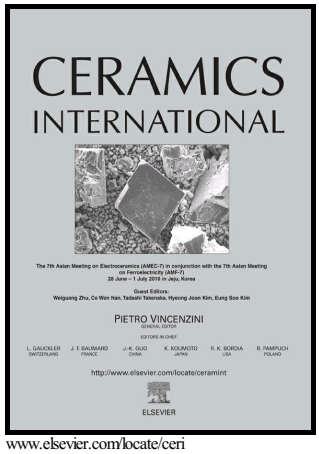

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Abstract

Ceramics-based additive manufacturing is a complex process and the solidification mechanism and microstructural evolution are currently not fully understood. In this work, Al_2O_3 single tracks were formed using a customised selective laser melting (SLM) system equipped with a high power diode laser. The effects of laser energy density (LED) on geometry, microstructure and micro-mechanical properties of Al_2O_3 tracks were investigated. To better understand the solidification mechanism, a transient three-dimensional thermal model was developed for predicting the thermal behaviour of the melt pool. The results indicated the use of high LED gave rise to decreased viscosity and surface tension of the molten alumina and led to localised melting of the substrate. Both, in turn, enabled the formation of a continuous solidified track. The solidified tracks were primarily composed of columnar dendrite. When relatively high LED (≥25.7 kJ/m) was applied, equiaxed dendrite appeared along the central line near the