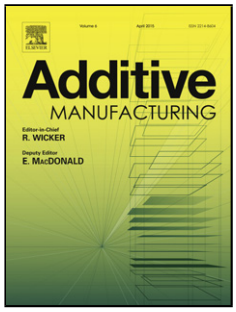

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LASER SINTERING PROCESS OF CERAMIC POWDERS: THE EFFECT OF PARTICLE SIZE ON THE MECHANICAL PROPERTIES OF SINTERED LAYERS

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Highlights

- Unimodal powder samples were used in the laser sintering process
- Different powder particle size and laser scan speeds were used
- Microphotography, bulk density and tensile strength of artefact were measured
- Neck size and strength were estimated with the Rumpf model for the strength of powder aggregates
- Sintering temperatures were estimated with the Frenkel model for the effect of time on the sintering process

Abstract

Selective Laser Sintering (SLS) of ceramic powders is studied in order to understand how the initial material properties and the process conditions affect the degree of sintering/melting and the mechanical properties of the sintered material. Unimodal powder samples of different narrow particle size distributions between 16 and 184 μm were sintered with a 40W CO_2 laser, using laser scan speeds of either 50 or 100 mm s^{-1} and, in both cases, a scanning energy of 160 J m^{-1}. The sintered material was studied by means of optical and SEM microphotography and characterized in terms of bulk density and tensile strength. The Rumpf approach to relate interparticle forces to the strength of powder agglomerates was used in this work to estimate the average strength of the sintered interparticle contacts starting from the tensile strength of specimens. In turn, the average strength of the neck contact was used to estimate the size of the neck of fused material between two sintered particles. These data coupled with the Frenkel model for particle sintering allowed an estimate of the sintering temperature for the different experimental conditions tested. The temperatures found are consistent with the glass transition temperature of the material used. The effect of particle size and scanning speed is assessed and discussed.

Keywords: Laser sintering; ceramic powders; additive manufacturing; particle size; mechanical properties; Frenkel model.