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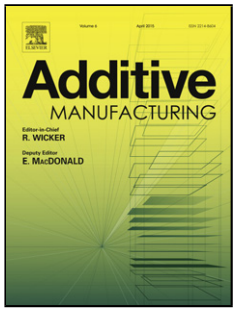

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Salah Eddine Brika, Morgan Letenneur, Christopher Alex Dion, Vladimir Brailovski

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Influence of particle morphology and size distribution on the powder flowability and laser powder bed fusion manufacturability of Ti-6Al-4V alloy

Salah Eddine Brika [1], Morgan Letenneur [1], Christopher Alex Dion [2], Vladimir Brailovski [1*]

[1] Department of Mechanical Engineering, École de technologie supérieure, 1100 Notre-Dame Street West, Montreal, QC H3C 1K3, Canada; salah-eddine.brika.1@etsmtl.net (S.B); morgan.letenneur.1@etsmtl.net (M.L.)

[2] Research and Development, PyroGenesis Additive, 1744, William St., Suite 200, Montréal, QC H3J 1R4, Canada; cdion@pyrogenesis.com

[*] Correspondence: vladimir.brailovski@etsmtl.ca; Tel.: +1-514-396-8594

Abstract:

Laser powder bed fusion (LPBF) additive manufacturing technology is sensitive to variations in powder particle morphology and size distribution. However, the absence of a clear link between the powder characteristics and the LPBF performances complicates the development, selection and quality control of LPBF powder feedstock. In this work, three Ti-6Al-4V powder lots produced by two different techniques, namely, plasma atomization and gas atomization, were selected and characterized. Following the micro-computed tomography analysis of the powder particles' morphology, size and density, the flowability of these powder lots was concurrently evaluated using Hall and Gustavsson flowmeters and an FT4 powder rheometer. Using established rheology-based criteria, a figure of merit was proposed to quantify the overall powder suitability for the LPBF process. Next, the same three powder lots were used to 3D-print and post-process a series of testing specimens with different layer thicknesses and build orientations, in order to establish a correlation between the powder characteristics and the geometric and mechanical properties of a final product. This study demonstrates that the use of highly spherical powders with a limited amount of fine particles promotes their flowability and yields LPBF components with improved mechanical and geometric characteristics.