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Defect Correlation of Computed Tomography and Serial Sectioning in Additively Manufactured Ti-6Al-4V

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Abstract : This study presents initial results toward the correlative characterization of inherent defects of Ti-6Al-4V additive manufacture (AM). X-Ray Computed Tomography (CT) defect data are compared and correlated with microscopic photographs obtained via automated serial sectioning. The metal AM specimen was manufactured out of Ti-6Al-4V virgin powder to specified dimensions. A post-contour was applied during the fabrication process with a speed of 1050 mm/s, power of 260 W, and a width of 140 µm. The specimen was stress relief heat-treated at 16°F for 3 hours. Microfocus CT imaging was accomplished on the specimen within a predetermined region of the build. Microfocus CT imaging was conducted with parameters optimized for Ti-6Al-4V additive manufacture. After CT imaging, a modified RoboMet. 3D version 2 was employed for serial sectioning and optical microscopy characterization of the same predetermined region. Automated montage capture with sub-micron resolution, bright-field reflection, 12-bit monochrome optical images were performed in an automated fashion. These optical images were post-processed to produce 2D and 3D data sets. This processing included thresholding and segmentation to improve visualization of defect features. The defects observed from optical imaging were compared and correlated with the defects observed from CT imaging over the same predetermined region of the specimen. Quantitative results of area fraction and equivalent pore diameters obtained via each method are presented for this correlation. It is shown that Microfocus CT imaging does not capture all inherent defects within this Ti-6Al-4V AM sample. Best practices for this correlative effort are also presented as well as the future direction of research resultant from this current study.

Keywords : additive manufacture, automated serial sectioning, computed tomography, nondestructive evaluation
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