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In Situ Characterization Methods of Additive Manufacturing Processes at the Stanford Synchrotron Light Source

Additive manufacturing promises to revolutionize American manufacturing by decreasing costs, increasing energy efficiency, enabling new component design motifs, and providing a manufacturing pathway for novel materials which cannot be processed by traditional means. However, the link between microstructure, which determines performance, and the fabrication processing parameters is not well understood. Using high speed X-ray imaging at the Stanford Synchrotron Radiation Lightsource at SLAC National Accelerator Laboratory, we have nondestructively visualized the dynamics of the melt pool and void formation during selective laser melting of Ti-6Al-4V. Coupled with computational models, we have used this approach to validate a mitigation strategy for pore formation at turnaround points. High speed in situ X-ray diffraction has also been used to determine subsurface cooling rates which are correlated with material microstructure. We will present our latest results in single layer powder bed selective laser melting chamber and discuss possible future directions for this work.

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