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Electron Beam Additive Fabrication Technology for Rapid Manufacturing of Space Vehicle Hardware

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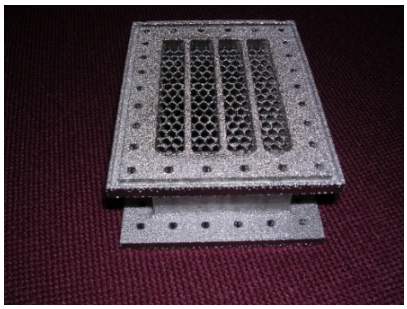

Example of a MSFC fabricated EBAF part: ECLSS subsystem test chamber.

Research: Electron Beam Additive Fabrication (EBAF) utilizes a high-energy electron beam to melt and fuse powders to build full-density parts in a layer-by-layer fashion. EBAF, a relatively new additive manufacturing (AM) technology, can fabricate metallic components, particularly of complex shapes, in an efficient and cost-effective manner compared to conventional manufacturing means. EBAF can be an enabling technology for rapid manufacturing (RM) of space vehicle hardware, and thus can effectually assist the design and development of next-generation spacecraft. However, space-related applications using EBAF remain limited because the effect of EBAF parameters on part characteristics and property variations is not fully understood.

Potential Impact: The overarching goal of this project is to broaden the effective usage of EBAF and, through fundamental process understanding, to advance rapid manufacturing of space vehicle hardware. Partnering with Marshall Space Flight Center (MSFC), this research will concentrate on EBAF of titanium alloy components. Research approaches include design of experiments, part fabrications and characterizations, mechanical evaluations, numerical models of the EBAF process physics including the thermal aspects and microstructural evolutions, and solid mechanics. Developed process models will be validated by basic experimentation to measure process variables including temperatures and melt-pool dynamics. Further, validated models will be applied to pursue NASA case evaluations of specific space vehicle hardware for EBAF applications.

RM technologies such as EBAF play a vital role in the hardware development of space vehicle systems. This collaborative research between The University of Alabama (UA) and MSFC will make contributions to both the fundamentals and space applications of EBAF, one of the core technologies in MSFC's National Center for Advanced Manufacturing. In addition to science and technology advancements, this project will establish diverse graduate research and education programs, involving both students and faculty from underrepresented groups, to increase future workforce in the aerospace engineering fields and to strengthen UA's research competitiveness.

http://www.uah.edu/ASGC/EPSCoR.php