Freeze-form Extrusion Fabrication of Ceramic Parts

Investigators:
Ming Leu (mleu@mst.edu, 573-341-4482), Greg Hilmas, Robert Landers, Len Rahaman, Roger Brown, Tieshu Huang, Shi Zhang, Lie Tang, Nikhil Doiphode, Michael Mason, Cathy Zhao, Catalin Roman, Brad Deuser, Anup Pendeyal, Ang Li, Diego Garcia, Michael Hayes, Stan Lawton, Sam Easley

Funding Source:
Air Force Research Laboratory, National Science Foundation, Boeing Company, Consortium for Bone and Tissue Repair and Regeneration (Missouri S&T)

Project Description:
This research investigates using the Freeze–form Extrusion Fabrication (FEF) process to fabricate complex 3D parts for aerospace and biomedical applications. Recently developed at Missouri S&T, FEF is an additive manufacturing process which involves layer-by-layer extrusion of aqueous pastes in a freezing environment. The parts that have been fabricated include aerospace structural components from high temperature and ultra-high temperature materials (alumina and zirconium diboride) and bone scaffolds from 13-93 bioglass. Current research focuses on fabricating composite structures grading from an ultra high temperature ceramic to a refractory metal. The research objectives are: (1) modeling the FEF process dynamics, (2) development of control algorithms for continuous extrusion and extrusion-on-demand, (3) evaluation of the FEF system for building parts from various pastes (including composite parts from functionally gradient materials), (4) investigating the part's dimensional changes after FEF, binder burnout, and sintering processes, and (5) evaluating the mechanical strength, density and microstructure of the specimens after sintering. More details of the project description is available on the weblink: http://web.mst.edu/~vram/projects.htm.

Publications: