Department of Materials Science and Engineering,

PhD Proposal

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Investigation of Local Elastic Strain in Additive Manufacturing using Electron Microscopy

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Abstract

Direct metal laser sintering (DMLS) is an additive manufacturing process with the potential to decrease time and waste of fabrication in aerospace, defense, and medical industries. DMLS fabrication of metal parts involves complex thermal histories and fast solidification processes, inducing local residual stress accommodated by elastic strains on the mesoscale in finished components. Residual stresses from the DMLS process can result in bulk distortion and can decrease the mechanical and material properties of a finished component. Simulation and prediction of elastic strains on this scale has been hampered by the difficulty in their characterization, including that of their evolution, and the anisotropic, non-equilibrium microstructure resulting from DMLS enhances these obstacles. Electron microscopy techniques including electron backscatter diffraction and precession electron diffraction have proven effective in the accurate characterization of elastic strain on subgrain and dislocation levels, creating the potential for correlation of specific microstructural features and solidification events to the resulting elastic strain in additively manufactured metals. I will utilize electron microscopy to explore the distribution and evolution of elastic strains and dislocation substructures in DMLS built parts to further the understanding and prediction of microscale stresses resulting from this advanced manufacturing technique.