Challenges & advancements in additive manufacturing of high strength aluminum alloys

Abstract

Additive manufacturing (AM) can be described as the process of joining or adding materials with the primary objective of making objects from three-dimensional (3D) model data using the layer-by-layer principle. While three-dimensional printers have been able to print metal parts successively, the process application is extendable to only few industrial alloys. Almost all the aluminum wrought alloys currently used in industry cannot be 3D printed mostly due to the alloy's susceptibility to hot tearing phenomenon. One of the major issues associated with AM of aluminum parts is the formation of columnar/directional grains that gives a significant mechanical anisotropy in the structural part. Sometimes heat treatment process alone is not even enough to prevent the directional grain growth, which eventually brings the hot isostatic pressing (HIP) as an obvious choice for the part manufacturers. However, this increases the price of the part significantly.

In this study, additively manufactured AlSi10Mg specimens were heat treated at varying temperatures and analyzed by optical and electron microscopes for metallographic characterization. Mechanical properties were determined by hardness and tensile testing. The impact of cooling rate on the microstructure and mechanical properties of additively manufactured AlSi10Mg was also studied by modifying the standard T6 heat treatment process to accommodate furnace and air-cooling during heat treatment. This research is further being expanded into analysing the effects of nanoparticles on the solidification/nucleation mechanism in additively manufactured AlSi10Mg.

Biography:

Dolly Clement is a current PhD student at Carleton University and obtained her Masters in Aerospace Engineering from Florida Institute of Technology, Florida, US. She also worked as a mechanical engineer for GE Aviation, Miami, Florida where she was primarily responsible for designing and testing of in-flight systems. Her background in R&D influenced her to pursue her doctorate at Carleton specializing in additive manufacturing of high strength aluminum alloys under the supervision of **Dr. Abu Syed Kabir.** Her current research areas include studying the microstructural behaviour of nano-particle reinforced aluminum alloys and characterizing their mechanical properties.