Mechanical Engineering Thesis Defense

Effect of Fused Deposition Modeling Printing Parameters on the Mechanical and Thermal Behavior of PLA/Nanodiamond Composite

School for Engineering of Matter, Transport and Energy

Nikhitha Poornabodha

Advisor: Dr. Qiong Nian

Abstract

Polylactic Acid (PLA), a thermoplastic polymer is well-known for its biocompatibility, making it ideal for the manufacturing of biomedical devices. However, the current applications of PLA are commonly limited by its intrinsic polymer characteristics, such as low modulus and mechanical strength, and thermal conductivity. To enhance these physical properties, a biocompatible Nanodiamond enhanced PLA filament has been studied. Thermogravimetric analysis was performed to unveil the composition of Nanodiamond in the composite. Four printing parameters: nozzle temperature, layer height, infill pattern and printing speed were considered and the Taguchi L9 orthogonal array was implemented for the design of experiments. Fused deposition modeling (FDM) technique was utilized to 3D print the PLA/Nanodiamond samples by altering the four printing parameters considered and were tested according to the standards for tensile strength, flexural strength, and thermal conductivity. Using the Taguchi optimization approach and analysis of variance (ANOVA), the generated experimental data was used to find the optimum set of printing parameters. Finally, cell studies were performed to demonstrate the biocompatibility of PLA/Nanodiamond. All these results could aid in determining the working ranges for FDM fabrication of PLA/Nanodiamond for biomedical applications.

April 7, 2022; 11 AM;

Zoom Link: https://asu.zoom.us/j/89581934535