Name: Isaac Liu
Title: Optimization of Printing Parameters for Low Molecular Mass Polymers: 4D Printing of Low

Printability Materials
Date of Presentation: July 29, 2021

Authors: Isaac Liu (Mechanical and Aerospace Engineering), Ping Liao (Mechanical and Aerospace Engineering), Dr. Jian Lin (Mechanical and Aerospace Engineering)

Submission category: Engineering
Funding: Materials Design and Processing NSF REU

Abstract: 3D printed stimuli-responsive materials have novel biomedical applications, due to its adaptability abilities. But many polymeric materials lack bio-compatibility, have unfavorable stimuli responses, and have poor printability. This prevents their wide-spread applications. Lin's Lab has developed two bio-compatible materials with shape-memory properties: poly (glycerol dodecanoate) (PGD) and poly (ethylene glycol dodecanedioic acid) (PEG-DDA). Despite their promising properties, both polymers have much lower molecule weights than other commercially available materials, causing poor printability. This project aimed to improve the printability of these two materials for printing a lattice structure by chemical modification and optimizing printing parameters. We optimized printing parameters of substrate, nozzle and bed temperatures, extrusion pressure, layer height, and printing speed on an Allevi 2 bioprinter. By measuring resolution and comparing supportability, we found temperature, printing speed, and surface tension to have the largest effects on printing quality. Poly (glycerol dodecanoate) acrylate (PGDA) shows better printability than PGD and PEG-DDA, which shows chemical modification is another option to improve the printability. Further development of this research will allow for printing of other low molecular weight polymers.