Mechanical Engineering Thesis Defense

Vat Photopolymerization of Recyclable Polymers with Tailorable Properties for Highly Removable Supporting

School for Engineering of Matter, Transport and Energy

Prem Kalpesh Nawab
Advisor: Xiangjia Li

Abstract

With increasing advance complexity in the structure to be 3D printed, the use of post processing removal of support structures has become more complicated thing due to the need of newer tool case to remove supports in such scenarios. Attempts have been made to study, research and experiment the dissolvable and recyclable photo-initiated polymeric resin that can be used to build support structure. Vat photo-polymerization method of manufacturing was selected due to wide range of materials that can be selected and researched which can have the potential to be selected further for large scale manufacturing. Deep understanding of the recyclable polymer was done by performing chemical and mechanical property test. Varying light intensities are used to study the curing properties and respective dissolving properties. In this thesis document, recyclable and dissolvable polymeric resin have been selected to print the support structures which can be later dissolved and recycled.

The resin was exposed to varying light projections using grayscales of 255, 200 and 150 showing different dissolving time of each structure. Dissolving time of the printed parts were studied by varying the surface to volume ratios of the part. Higher the surface to volume ratios of the printed part resulted in lower time it takes to dissolve the part in the dissolving solution. The mechanical strengths of the recycled part were found to be pretty solid as compared to the freshly prepared resin, good sign of using it for multiple times without degrading its strength. Cactus shaped model was printed using commercial red resin and supports with the recyclable solution to deeply understand the working and dissolving properties of recyclable resin. Without any external efforts, the supports were easily dissolved in the solution, leaving the cactus intact. Further work is carried on printing Meta shaped gyroid lattice structure in effort to lower the dissolving time of the supports while maintaining enough mechanical stress. Future efforts will be made to conduct the rheology test and further lower the dissolving time as much it can to be ready for the commercial large scale applications.

April 12, 2023; 3 PM; PSH 433