

Fabrication of high performing functional 3D micro devices using additive manufacturing

Three-dimensional printing technologies also known as additive manufacturing is currently revolutionizing the current manufacturing sector owing to their unique capabilities in fabricating parts with high complexity while reducing waste material and capital cost. However, the application of additive manufacturing is limited to commonly-used non-functional parts and components which cannot be integrated in high-technology needs. The use of 3D printing technologies for the fabrication of functional 3D micro devices is of special interest considering the manufacturing challenges, elevated complexity and use of advanced engineering materials. This research focusses on the fabrication of functional 3D micro devices using additive manufacturing. These functional 3D micro devices find applications in wide range of sectors including energy, biomedical and environmental applications. The study investigates questions in additive manufacturing of functional materials including the effects of critical process parameters on the strength and stiffness of the functional 3D printed components. The quality of the functional 3D micro devices will be evaluated considering the part density, tensile strength, dimensional accuracy, and surface roughness. The fabrication procedure in this study will involve a multi-step process based on an in-house built multi-material printable fused deposition model (FDM) 3D printer. The setup will be used as a means to fabricate micro devices that can be embedded into a larger system. The 3D printed micro device can further demonstrate the longevity of its life while adding in situ monitoring capabilities at various stages of 3D printing process. The study is expected to create knowledge to expand the capabilities and material selection choices of the current additive manufacturing technologies.