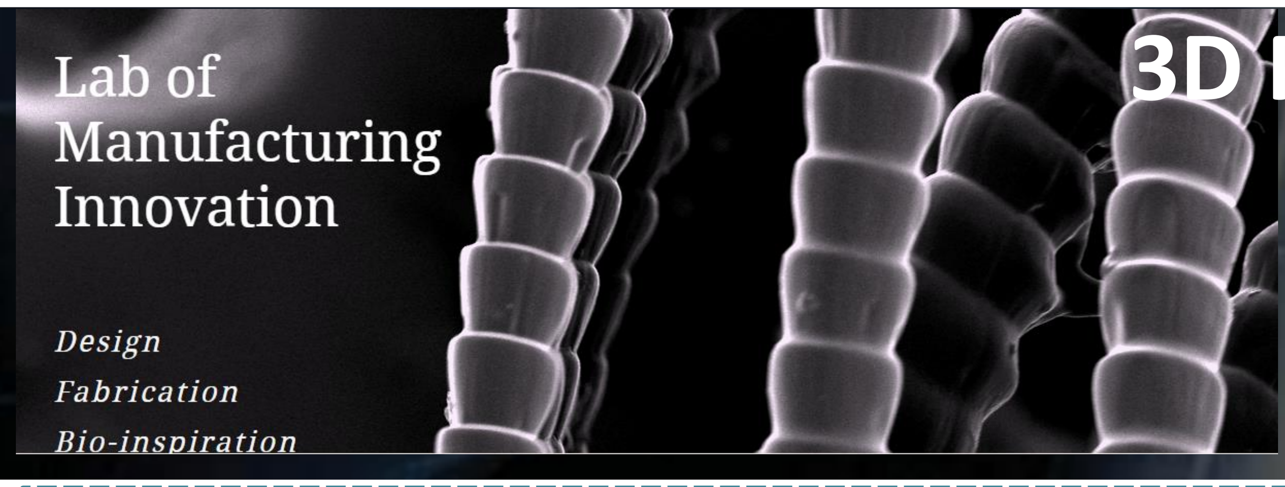

3D Printing of Multimetal Structures using Ultrafast Layerless Continuous Printing with Material Exchange

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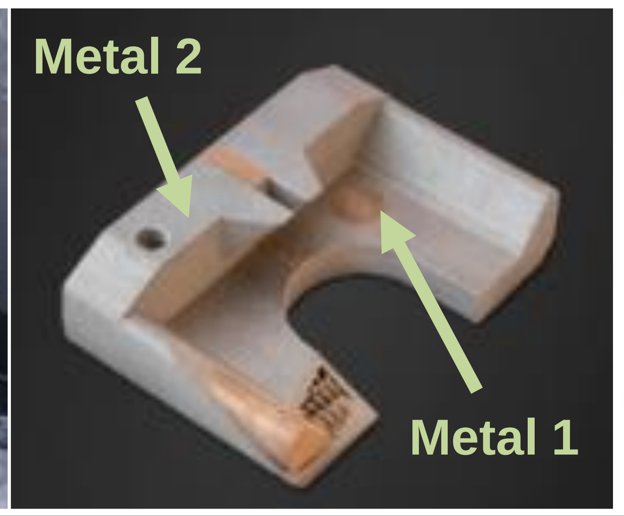
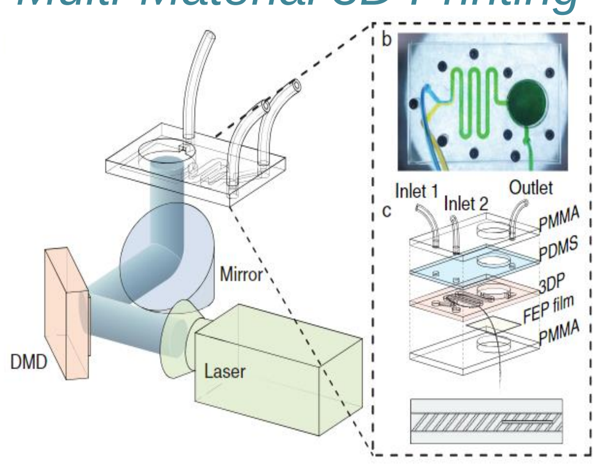
1. Motivation & Overview

Recently, metal additive manufacturing (AM), also known as metal 3D printing has become an ideal technology for designing unique and intricate metal components that are difficult to achieve using conventional manufacturing methods. Powder bed fusion (PBF) and selective laser melting (SLM) are the two leading methods however due to the drawbacks of their processes employ distinct particle fusion mechanisms to produce metal parts in the form of melting or sintering; the characteristics of the finished part depend heavily on the cyclic mechanisms involved in the super-rapid melting and solidification of the metal powder during laser scanning. Conversely, vat photopolymerization 3D printing, which cures a photocurable ink at predetermined location, can circumvent challenges related to material exchange process during printing.



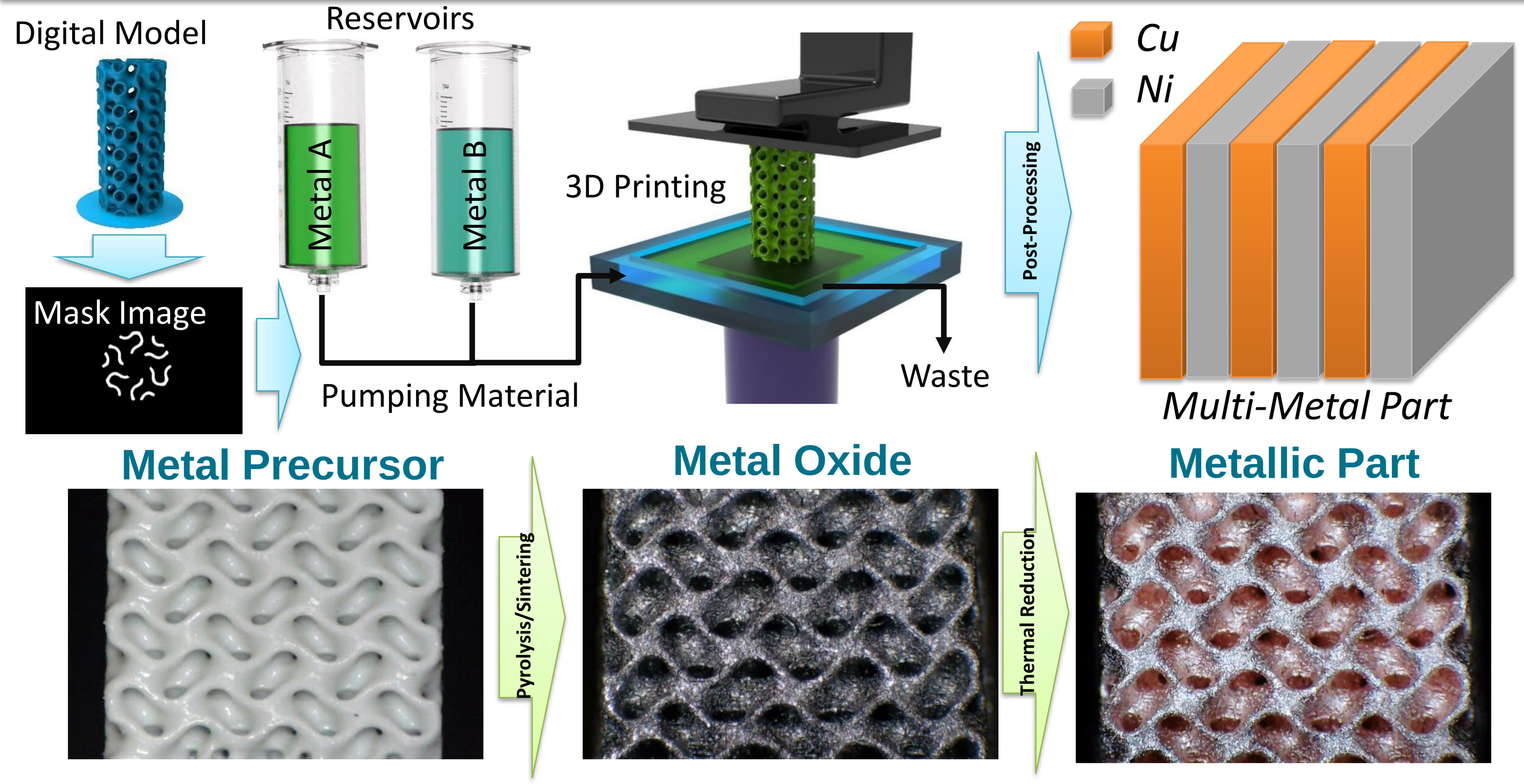
Multi-Material 3D Printing



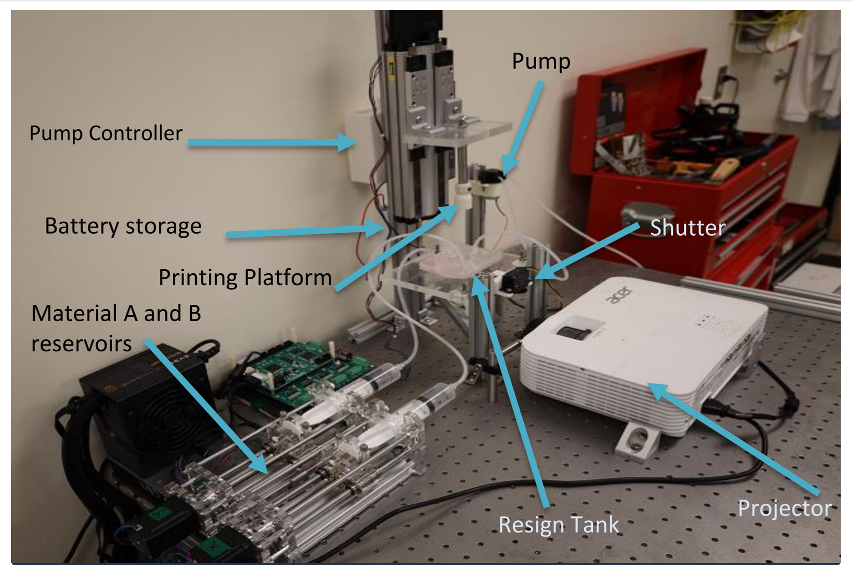
2. Abstract

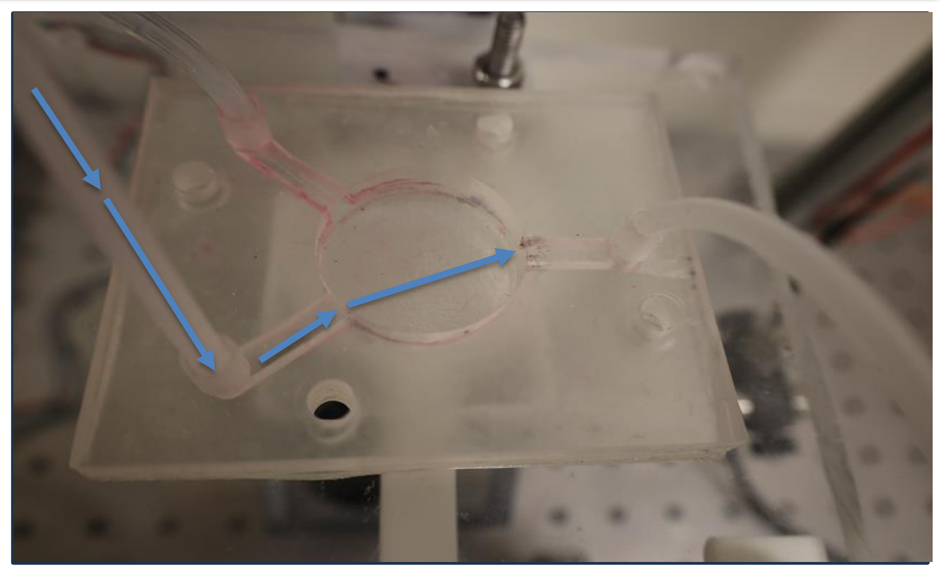
Mask image-based vat photopolymerization 3D printing, which selectively cures photoreactive resin, is an ideal technology for fabricating multi-material objects by integrating a material exchange process during printing. Currently, two common metal additive manufacturing technologies, powder bed fusion (PBF) and material extrusion, are limited to a small range of printable materials and require specialized equipment that can be costly to the end user. The objective of this project is to construct a low-cost vat photopolymerization printer that is capable of interchanging photocurable metal precursor materials to obtain a multimetal structure using a layer-based approach.

3. Fabrication Overview of Multi-Metal Structures



4. Construction of Multi-Metal 3D Printer

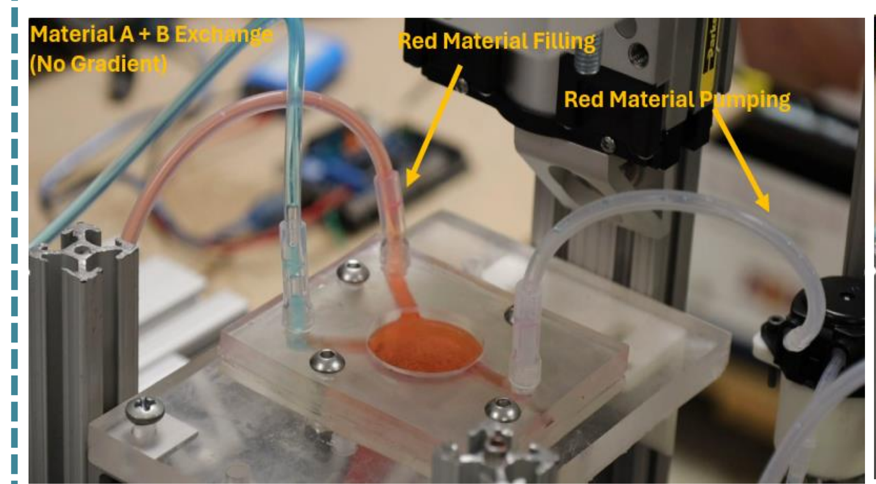


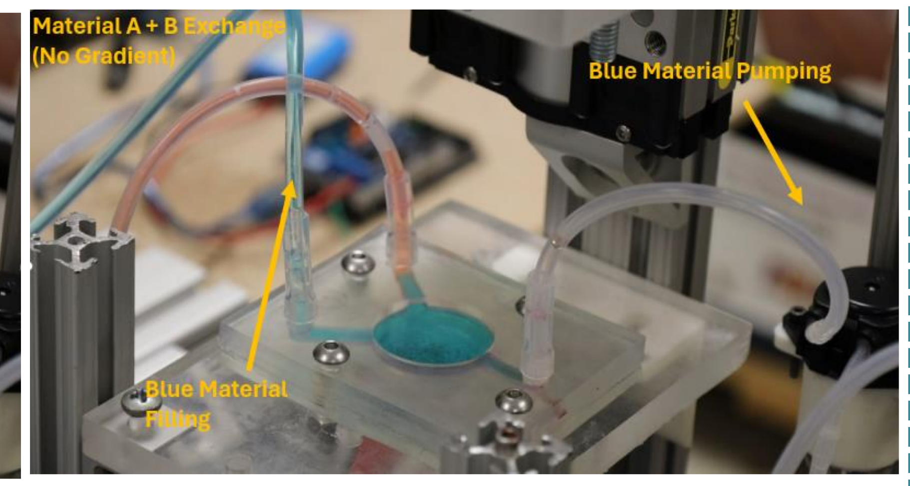


The printing setup consists of two syringes, one holding material A and the other holding material B. The material is pushed into the printed area via a motor and then pumped out to waste. The resign tank was designed and printed to allow easy deposition and extraction of printing material from the print region. A shutter was designed so that when the material exchange process is taking place the light from the projector would be blocked to prevent additional curing of the part. The power and controller of the pump are stored on the back of the printer.

5. Demonstration of Material Exchange Process

This design allows for multi-metal parts to be printed in sections for example the first half of the part using material A and the second half of the part using material B. Due to this process, multi-metal components with inner cores or selectively placed metal patterns can be fabricated in a single print, This allows for the creation of extremely unique parts that can be extremely porous requiring shorter print times and creating homogeneous microstructure compared with traditional additive manufacturing methods.





6. Future Work

1. Create multiple green bodies to be tested
2. Refinement of the gradient printing process

7. Acknowledgements

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8. References

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