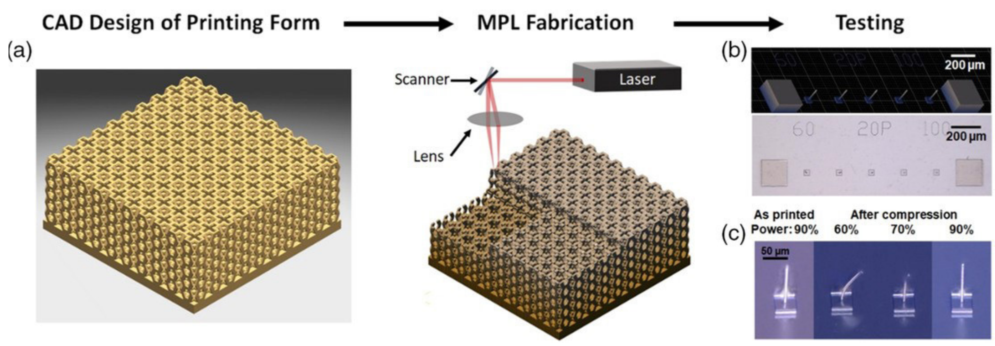
ARCHITECTED POROUS STAMP
FOR LIQUID TRANSFER PRINTING

Patent Pending
SD 15244
Technology Readiness Level: 3
Critical function demonstrated

An architected porous stamp fabricated using multiphoton lithography (MPL) can achieve very fine tunable features and exceptional control in liquid transfer printing

Mass production roll-to-roll printing techniques such as flexography, gravure, and offset are undergoing re-examination for their suitability in the emerging area of printed electronics. These methods rely on high speed ink-transfer mechanisms using direct print-form to substrate contact. Commonly occurring defects such as haloing, featuring, and bridging can impact the performance of printed materials for electronics applications. To improve the viability of these approaches, strategies are needed to increase print fidelity and film uniformity.

Sandia researchers have developed a microscale print form that can achieve very fine, tunable features and exceptional control during liquid transfer printing processes. The stamp is designed with tunable and layered Poisson's ratio to dictate capillary forces that effectively meter fluid transfer through architected porosity. The print form was fabricated using multiphoton lithography (MPL), a microscale additive manufacturing technique that enables submicron feature sizes. This new technique offers advanced control of fluid uptake and dispensing and can be used to develop more sophisticated liquid transfer processes for emerging applications such as solar cell metallization and printed circuits.



a) Schematic workflow showing CAD drawing of a 3D part and the MPL fabrication using the output of a laser coupled to a galvo scanner. b) Schematic showing test design to understand compression characteristics of individual MPL fibers (top) and top-down image of printed fibers (bottom). c) Images showing MPL fibers fabricated with varying laser power following compression.

Technical Benefits

- Improved efficiency and performance in mass production applications
- Reduced defects and blemishes with higher throughput

Industries & Applications

- Additive manufacturing, specifically high-speed roll-to-roll flexography
- Printed electronics and components
- Medical device fabrication
- Textile production

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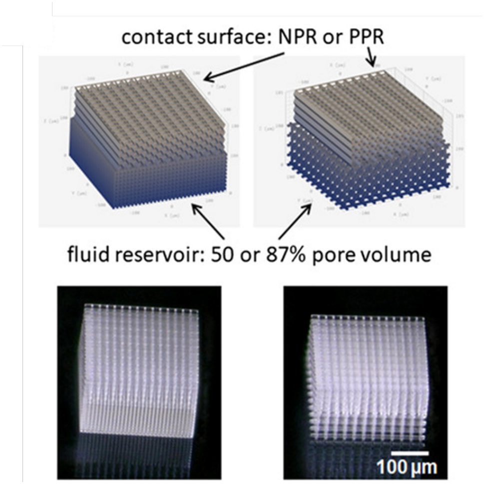
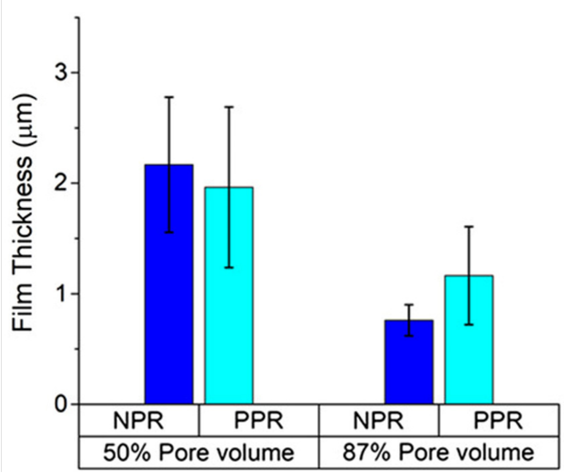
Additional Figures





Left: Design and corresponding microscopy images of stamp forms with negative Poisson's ratio (NPR) and positive Poisson's ratio (PPR) surface features. Right: Printed film thickness for different structures, showing variation based on microstructure.

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