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MEMS for Fabrication of Optical Metamaterials[1] THOMAS STARK, LAWRENCE BARRETT, JEREMY REEVES, RICHARD LALLY, DAVID BISHOP, Boston Univ — Optical metamaterials are typically fabricated using conventional nanofabrication techniques. Many techniques require resists and are limited to flat substrates that are chemically compatible with the resist and liftoff solvents. Furthermore, improved resolution is typically accompanied by decreased throughput. We present a microelectromechanical systems (MEMS)-based, resist-free nanofabrication method for fabricating metamaterials on arbitrary substrates. The MEMS consists of a moveable stencil, which can be actuated with nanometer precision using electrostatic comb drive actuators. A flip chip technique enables us to evaporate metals through the MEMS device handle and MEMS stencil for fabrication on an external substrate. While the MEMS method can cover an area of approximately 100 square microns with a single stencil, we use many devices in parallel, combined with a piezo stage to step and repeat fabrication over a cm^2 range, enabling us to maintain both high resolution and throughput. Fabricating metamaterials on new substrates will enable novel and tunable metamaterials. For example, by fabricating unit cells on a periodic auxetic mechanical scaffold, the optical properties can be tuned by straining the mechanical scaffold.

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