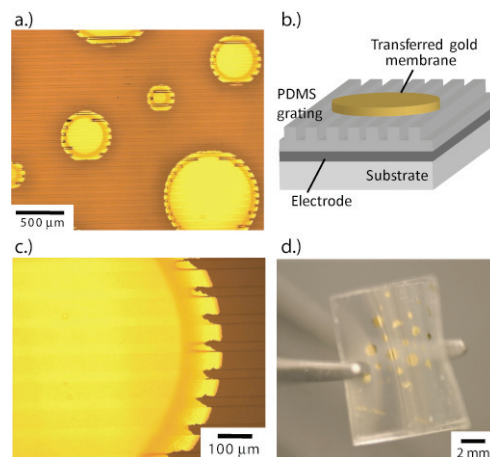


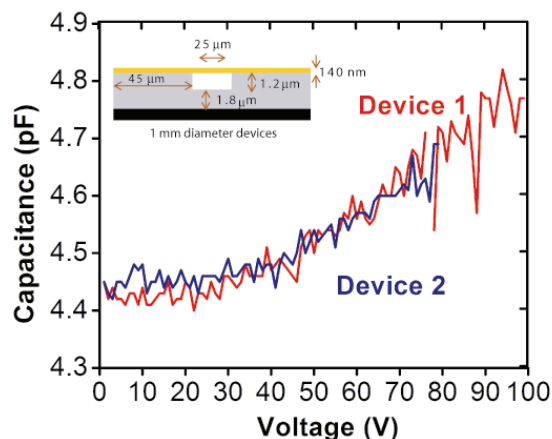
## Direct Patterning of Metallic MEMS through Microcontact Printing

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Standard photolithography-based methods for fabricating microelectromechanical systems (MEMS) present several drawbacks including expense, incompatibility with flexible substrates, and limitations to wafer-sized device arrays. We have developed a new fabrication method for rapid fabrication of large-area MEMS that breaks the paradigm of lithographic processing using a scalable, large area microcontact printing method to define three-dimensional electromechanical structures. Our PDMS Lift-Off Transfer (PLOT) involves the rapid removal of a pick-up stamp from a transfer pad to transfer a continuous metal film from the pad to the stamp. A stamp that forms the membrane suspension supports is fabricated by molding a thin layer of PDMS against a silicon master with a predefined relief. The metal membranes are deposited by thermal evaporation onto a transfer pad which has been prepared with an organic molecular release layer. To achieve transfer of the metal membrane over the supports of the device, the stamp is brought into conformal contact with the transfer pad and then released by rapidly peeling away. MEMS bridge structures, such as the ones shown in Figure 1, have been fabricated using PLOT, and their performance as variable capacitors has been characterized. In Figure 2, the capacitance of these devices increases with applied voltage, indicating mechanical deflection of the bridges due to the electrostatic force. PLOT forms MEMS structures without requiring elevated temperature processing, high pressure, or wet chemical or aggressive plasma release etches, providing compatibility with sensitive material sets for the fabrication of integrated micro- or opto-electronic/MEMS circuits. Flexible, paper-thin device arrays produced by this method may enable such applications as pressure sensing skins for aerodynamics, phased array detectors for acoustic imaging, and novel adaptive-texture display applications.



**FIGURE 1:** Devices formed by PLOT: optical micrographs (a. & c.), schematic (b.) and photograph of devices formed on a flexible substrate (d.)



**FIGURE 2:** Capacitance increases with applied voltage in two devices, indicating mechanical deflection of the bridging metal film.