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Atomic Calligraphy MATTHIAS IMBODEN, Boston University, FLAVIO PARDO, CRISTIAN BOLLE, Bell Labs / Alcatel-Lucent, HAN HAN, AMMAR TAREEN, JACKSON CHANG, JASON CHRISTOPHER, BENJAMIN CORMAN, DAVID BISHOP, Boston University — Here we present a MEMS based method to fabricate devices with a small number of atoms. In standard semiconductor fabrication, a large amount of material is deposited, after which etching removes what is not wanted. This technique breaks down for structures that approach the single atom limit, as it is inconceivable to etch away all but one atom. What is needed is a bottom up method with single or near single atom precision. We demonstrate a MEMS device that enables nanometer position controlled deposition of gold atoms. A digitally driven plate is swept as a flux of gold atoms passes through an aperture. Appling voltages on four comb capacitors connected to the central plate by tethers enable nanometer lateral precision in the xy plane over 15x15 sq. microns. Typical MEMS structures have manufacturing resolutions on the order of a micron. Using a FIB it is possible to mill apertures as small as 10 nm in diameter. Assuming a low incident atomic flux, as well as an integrated MEMS based shutter with microsecond response time, it becomes possible to deposit single atoms. Due to their small size and low power consumption, such nano-printers can be mounted directly in a cryogenic system at ultrahigh vacuum to deposit clean quench condensed metallic structures.

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