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Fabricating quench condensed lead thin film circuits using MEMS Fab on a Chip technology MATTHIAS IMBODEN, HAN HAN, Boston University, PABLO DEL CORRO, Instituto Balseiro, Centro Atomico Bariloche, FLAVIO PARDO, CRISTIAN BOLLE, Bell Labs, Alcatel-Lucent, DAVID BISHOP, Boston University — We have developed a MEMS Fab on a Chip consisting of micro-sources, mass sensors, heaters/thermometers, shutters and a dynamic stencil. The fab only occupies a volume of a few cubic millimeters and consumes milliwatts of power, and hence can be operated in a cryostat. Thin film patterns of arbitrary shapes using multiple materials can be manufactured, while strongly suppressing thermal annealing effects. We demonstrate deposition of quench condensed lead films with fractions of a monolayer thickness control. Furthermore, using low deposition rates it is estimated that the surface temperature of the target heats by only 1.7 K. We study the effects of growing quench condensed films with different evaporation rates to demonstrate thermal annealing effects which occur during deposition. We measure the minimum conduction thickness (insulator to metal transition) as well as the superconducting transition temperature as a function of film thickness in order to shed light on growth of amorphous films and the transition to nanocluster formations. The Fab on a Chip will allow us to build nanocircuits made of ultra-thin materials. Annealing and doping is controlled and measurements occur in situ, without exposing the fabricated circuits to thermal fluctuations or foreign contaminants. This enables new types of experiments based on quantum circuits which cannot be fabricated using standard lithography techniques.

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