Projects at the EPFL Center of MicroNanoTechnology

LITHOGRAPHY AND FOCUSED ION BEAM SAMPLE PREPARATION: A COMPARISON AND A COMBINED APPROACH

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Project objective:

Silicon pillars of various dimensions were fabricated by microfabrication procedures and focused ion beam (FIB) machining. Micro-compression tests revealed an ultrahigh elastic strain limit and plastic deformation behavior for pillars produced by lithography. The superior mechanical response of these pillars compared to FIB-machined pillars is attributed to the undamaged, free surfaces obtained by plasma etching. Further, we explore a combined approach of lithography and FIB processes for a high-throughput sample production of more complex geometries.

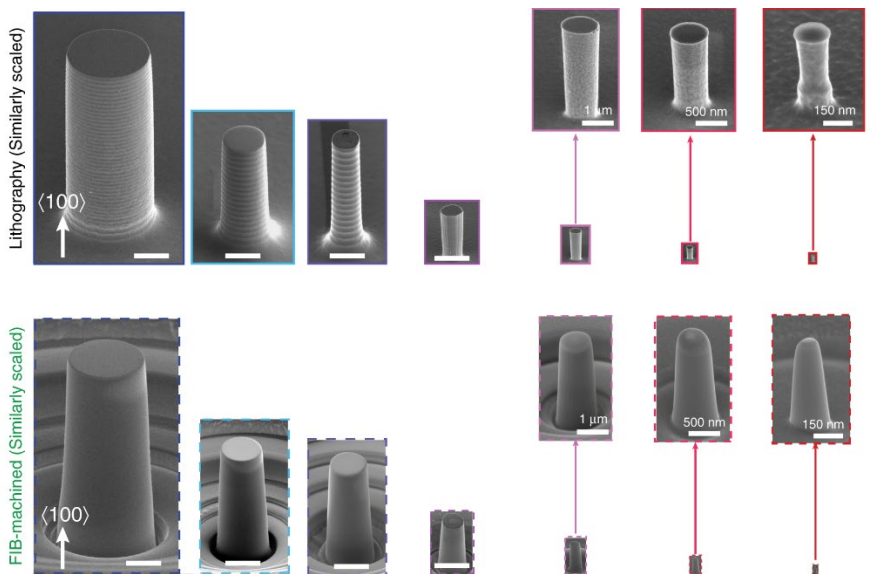

Figure 1: Silicon pillars of various diameters fabricated by lithography processing (first row) and FIB machining (second row) [1].

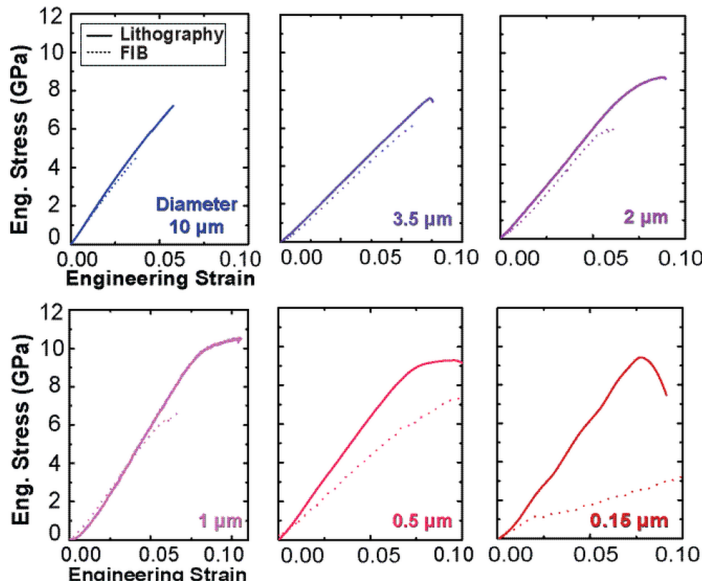

Figure 2: Stress-strain curves reveal that lithographic pillars show a higher elastic strain limit and exhibit plastic deformation at the micron-scale (D<2 um) [1].

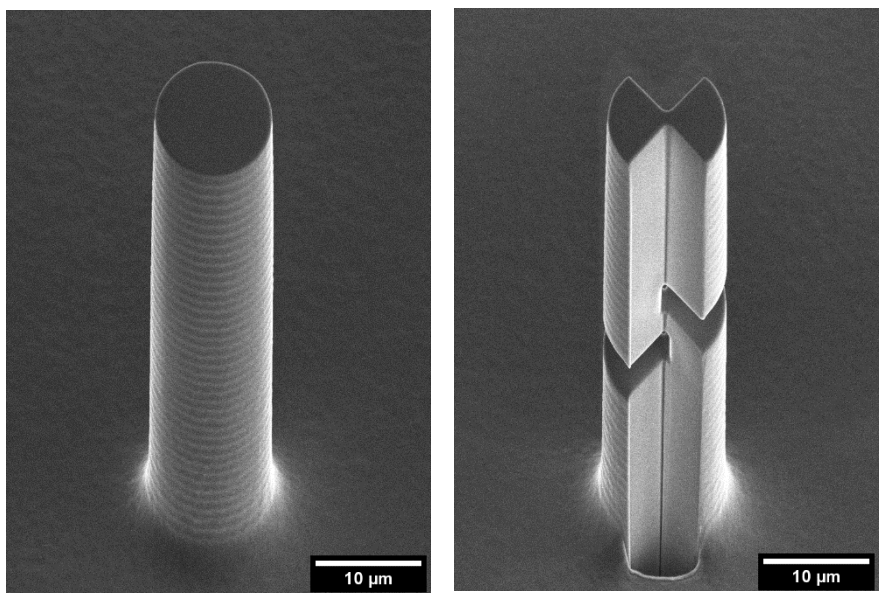

Figure 3: Left: Micropillar patterned by lithography. Right: modified pillar using FIB machining in order to achieve complex stress states by uniaxial loading.

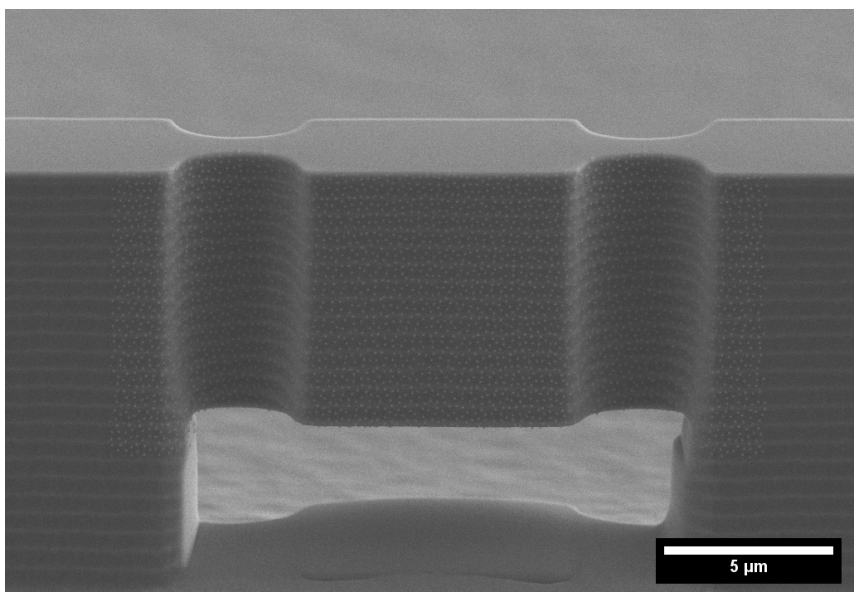

Figure 4: Patterned wall fabricated by lithography processing. Subsequent FIB milling creates a suspended structure.

Techniques employed: DLW, e-beam lithography, dry etch, wet oxidation, wet etch.

Publications:

[1] Chen, M., Pethö, L., Sologubenko, A.S. *et al.* Achieving micron-scale plasticity and theoretical strength in Silicon. *Nat Commun* **11,** 2681 (2020).

Funding: SNSF, ETH Grant