Bruker/Hysitron TriboIndenter: Micro Pillar Compression

PILLAR COMPRESSION:

• Pillar compression provides a method to evaluate mechanical properties of a material at micro to nano scale.
•Yield strength and deformation behavior can be obtained from a site-specific test sample.

SAMPLE

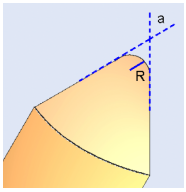
• The pillar can be easily made by using automated focused ion beam (FIB) recipe from any selected area of interest on a sample within a dual beam SEM/FIB system.
• A standard SEM sample stub can be installed on Triboindenter stage directly, which makes it convenient to transfer sample from SEM imaging to Triboindenter micro pillar compression test.

TRANSDUCER

Both standard transducers and high load transducer (HL) can be used for pillar compression test depending on the load or displacement to be applied. Standard transducer has a limited 10mN maximum load and 5um maximum displacement. High load transducer has a 12N maximum load and 97um maximum displacement.

PROBES

Usually a conical or flat end probe is preferred for compression test. For standard transducer, the following conical probes (tip radius R / cone angles α) are available at (MC)²: 50um/90°, 5um/60°, 1um/90°. For HL transducer, a 50um/60° is available. Other size probe could be purchased from Bruker.



PROBE POSITIONING

An optical microscope installed next to the transducers is used for visual observation of sample surface before compression test. Probe tip could be coarsely positioned within one micron resolution with the help of the optics. For sub-micron diameter pillar, in-situ SPM imaging could be used for probe placement within 10nm resolution. SPM imaging is only applicable to the standard transducers, but not for HL transducer.

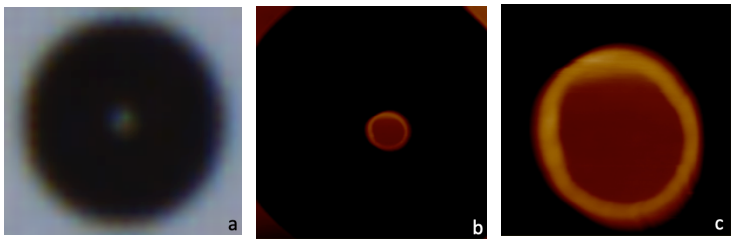
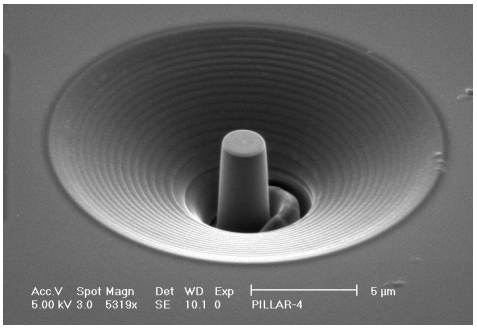
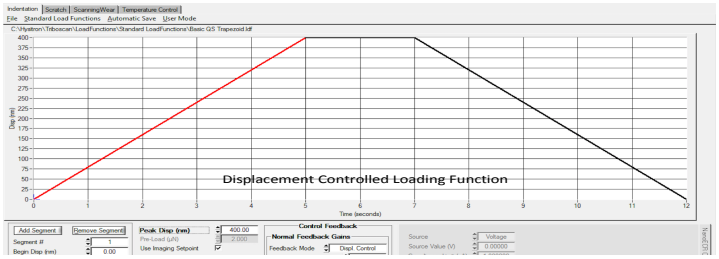


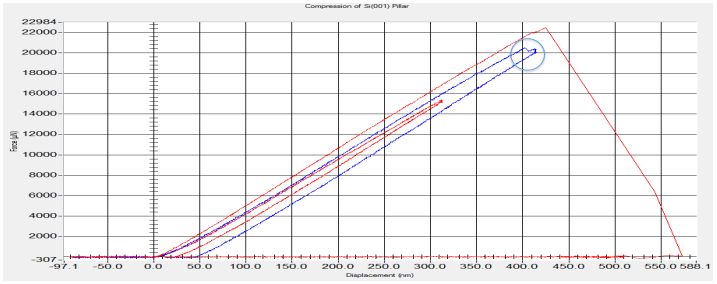
Figure (a) is an optical image of a 2um diameter pillar made of Si. Figure (b) and (c) are two SPM images of the same Si pillar in figure (a). Data by Haiping Sun, MC2.

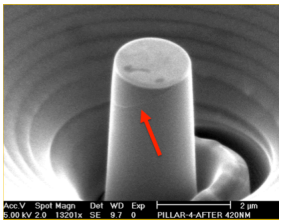


A 2 µm diameter and 5 µm height Si pillar with <100> axis orientation could be made in 30 minutes. Pillar prepared by Allen Hunter, MC2.

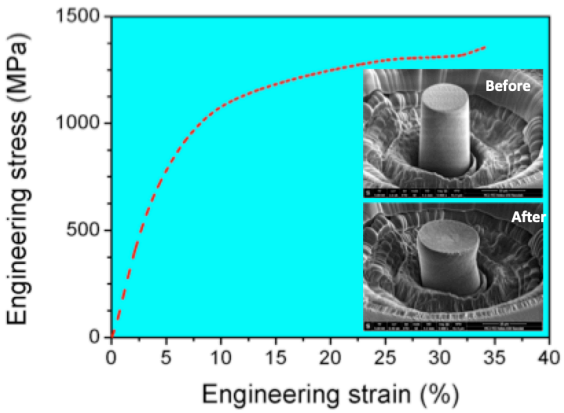


An example of a basic quasi-static trapezoid load function used for displacement control micro pillar compression testing.





A kink on the blue loading curve appears at a displacement of about 390nm, which indicates the occurrence of a slip band that can also be revealed from SEM image on the left. Data by Haiping Sun, MC2.



Data by Qian Lei in Amit Misra group, MSE, CoE, University of Michigan