850
doi:10.1017/S1431927619004987
Microsc. Microanal. 25 (Suppl 2), 2019

Avoiding FIB damage using the "umbrella" method

C.C. Tasan[1], T. Vermeij[1,2], E. Plancher[1]

[1]Massachusetts Institute of Technology, Department of Materials Science and Engineering, 77 Massachusetts Avenue, Cambridge, MA 02139, USA
[2]Eindhoven University of Technology, Department of Mechanical Engineering, Den Dolech 2, 5612 AZ Eindhoven, The Netherlands
* Corresponding author: tasan@mit.edu

We use focused ion beam (FIB) milling in several key microstructure characterization techniques (*e.g.* 3D electron backscatter diffraction (EBSD), 3D scanning electron microscopy imaging, site-specific sample preparation for transmission electron microscopy, site-specific atom probe tomography), and micro-mechanical testing techniques (*e.g.* micro-pillar compression, micro-beam bending, in-situ TEM nanoindentation). Yet, in most milling conditions, it is unavoidable to have some degree of FIB damage. FIB damage can be introduced via material redeposition, Ga^+ ion implantation or another mechanism. The level of damage and its influence vary strongly with milling conditions and materials characteristics, and cannot always be minimized.

Here, a masking technique is introduced, that employs standard FIB-SEM equipment to protect specific surfaces from redeposition and ion implantation [1]. Schematic representation of this "umbrella" method is shown in Fig. 1a. The actual images of the umbrella fabrication are shown in Fig. 1b-e. As a first step, PDMS micro pillars are moulded by soft lithography (Fig. 1b). Fig. 1c shows roughly shaped umbrella resting on a Si substrate, with the micro-manipulator in view. Next, the the bottom of the umbrella needs to be coated with Pt (Fig. 1d). The inset here shows the configuration used to cut the bottom surface flat. Final umbrella attached to the micro-manipulator is shown in Fig. 1e. The scale bars represents 5 μm in each image.

To investigate the efficiency of this technique, high angular resolution EBSD (HR-EBSD) has been used to monitor the quality of the top surface of several micro-pillars, as they were created by milling a ringcore hole in a stress-free silicon wafer, with or without protection due to an "umbrella". HR-EBSD provides a high-sensitivity estimation of the amount of FIB damage on the surface. Without the umbrella, EBSD patterns are severely influenced, especially within 5 μm of the milled region. With an optimized umbrella, sharp diffraction patterns are obtained near the hole, as revealed by average cross correlation factors greater than 0.9 and equivalent phantom strains of the order 2×10^{-4}. Thus, the umbrella method is an efficient and versatile tool to support a variety of FIB based techniques.

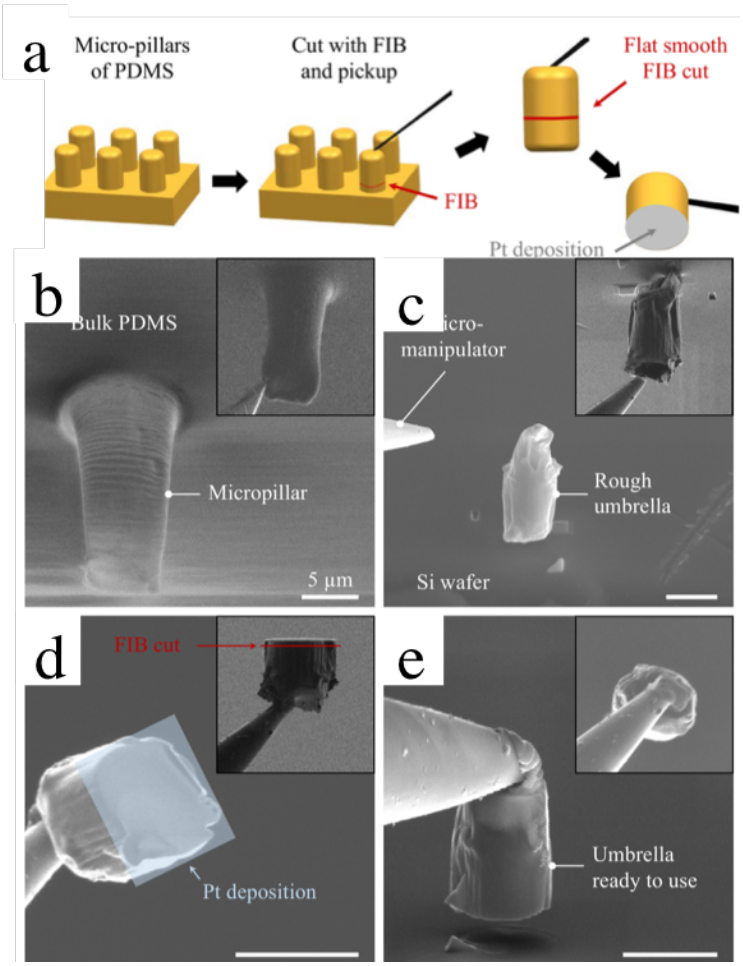

Figure *1*. The method.

References

[1] T. Vermeij, E. Plancher, C.C. Tasan, Ultramicroscopy 186 (2018) p 35.

https://doi.org/10.1017/S1431927619004987 Published online by Cambridge University Press