Push-to-Pull (PTP) Device

Quantitative In-Situ Tensile Testing with the Hysitron PI Series PicoIndenters

Small-scale materials and nanostructures are attracting considerable worldwide research interest due to their potential applications. Even though small-scale materials are paramount for their respective applications, an understanding of the mechanical properties of such small volumes of materials is far from clear due to the lack of an appropriate test technique that is quantitative at such small scales. To accommodate this need for testing mechanical properties of materials at nanoscale, Bruker offers the Push-to-Pull (PTP) Device, an in-situ tensile apparatus designed to work seamlessly with Hysitron® PI Series PicoIndenters for TEM and SEM.

The PTP apparatus not only enables quantitative tensile load-displacement data simultaneously with real-time imaging of the microstructure behavior, it also simplifies the sample preparation procedure, and serves as an energy buffer, strain sensor, and force calibration.

Push-to-Pull Device Features

- Quantitative tensile load-displacement data simutaneously acquired with real-time imaging of the microstructural behavior
- Device portability for easy transfer between FIB and SEM/TEM
- Easy insert in commercially available Hysitron PI Series PicoIndenters for in-situ tensile testing
- Consumable, multi-use MEMS-fabricated apparatus
- Single device compatibilty with both SEM and TEM Hysitron PicoIndenter instruments
- Three different stiffness values (15, 150, and 450 N/m) available for use with a variety of materials and sizes

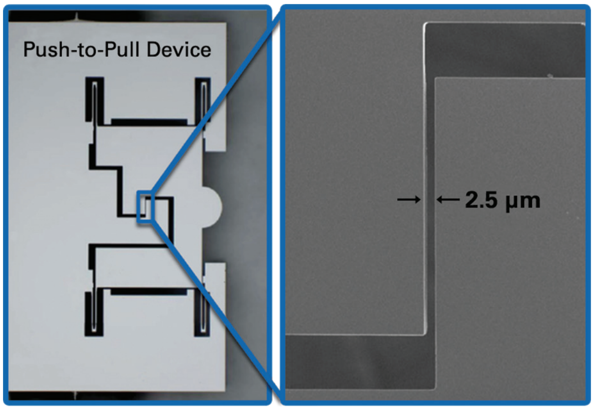

Figure 1. Optical image of a PTP device (left) and SEM image of the PTP device gap (right).

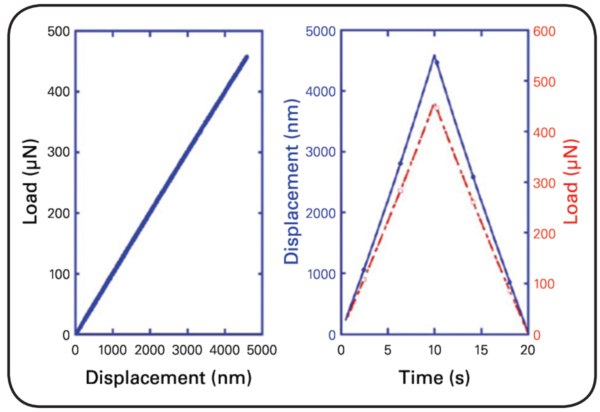

Figure 2. Load/unload vs. displacement curve (left), and displacement and load vs. time from PTP device deflection (right). Note that the linear elastic travel distance was more than 4 µm.

Example Application:
Mechanical Properties of One Dimensional ZnO Nanostructures

By: Zhiwei Shan[1,2], et al.
1. HARCC, Xi'an, China
2. CAMP-nano, Xi'an Jiaotong University, Xi'an, China

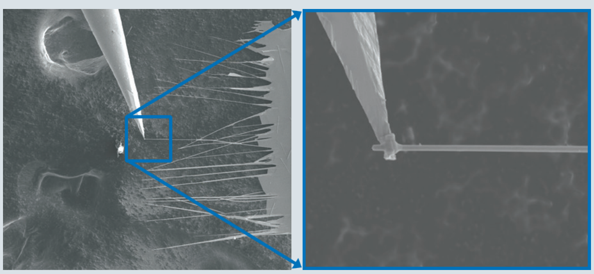

Figure 3. TEM images of nanomanipulation probe used to prepare ZnO samples; FIB was used for sample cutting.

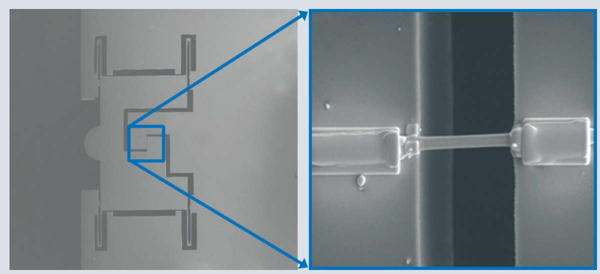

Figure 4. TEM images of full PTP device with mounted ZnO sample (left) and close-up of PTP device gap with ZnO sample mounted using FIB Pt deposition (right).

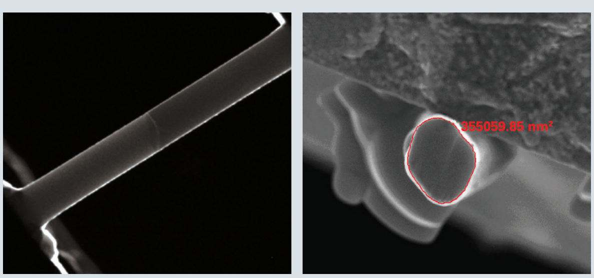

Figure 5. TEM images of ZnO in PTP device (left) and cross-section for calculation of area used in stress and Young's modulus calculations (right).

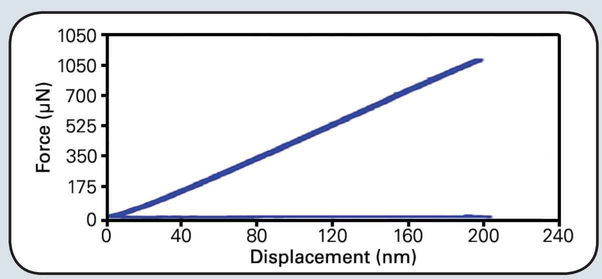

Figure 6. Load-displacement plot from in-situ ZnO tensile test using PTP device.

Acknowledgements:

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Bruker Nano Surfaces Division

Minneapolis, MN • USA
Phone +1.952.835.6366
productinfo@bruker.com

www.bruker.com/nanomechanical-testing