Fabrication of micropillars using Dual-beam Scanning Electron Microscope

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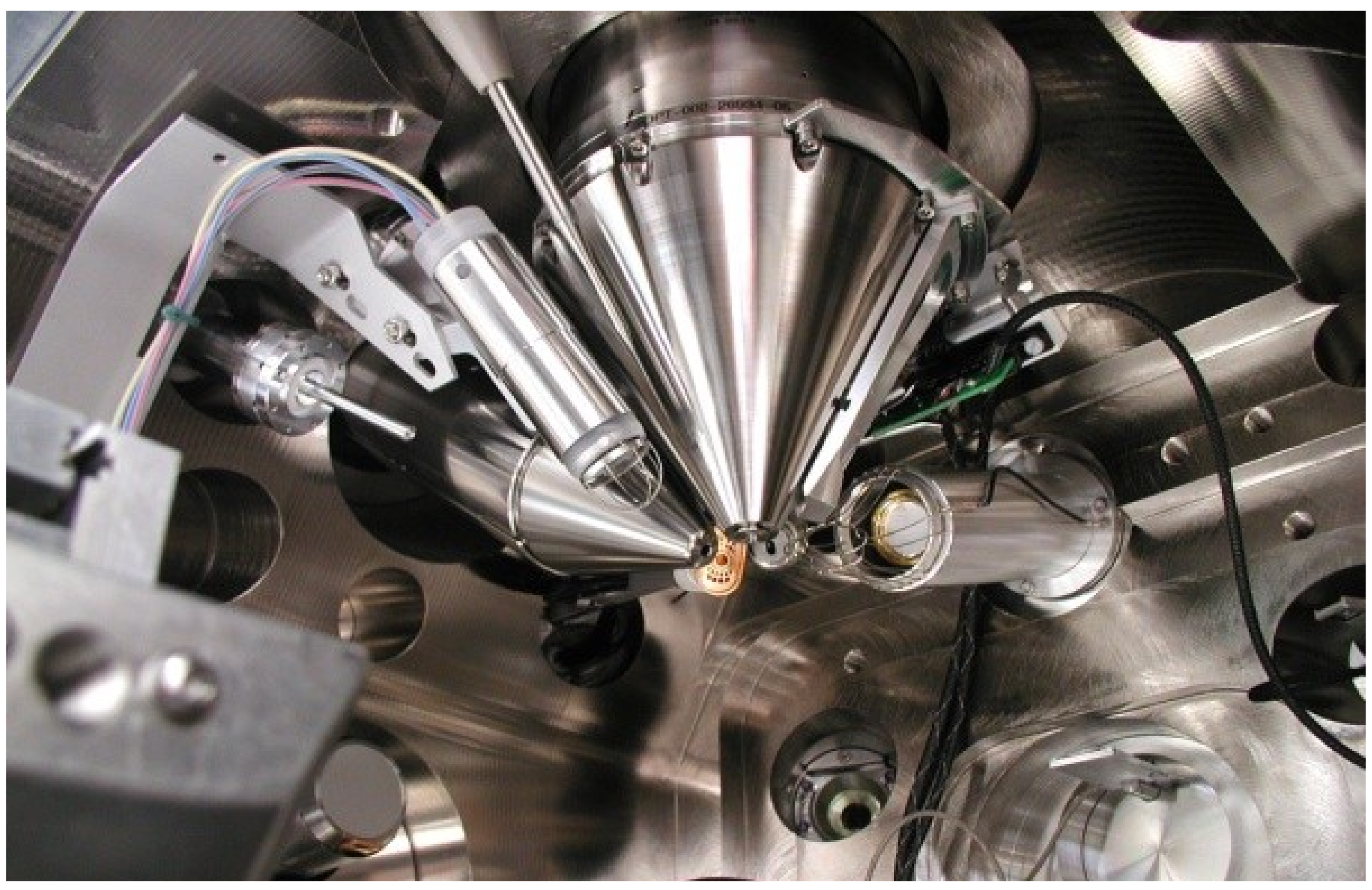


Introduction

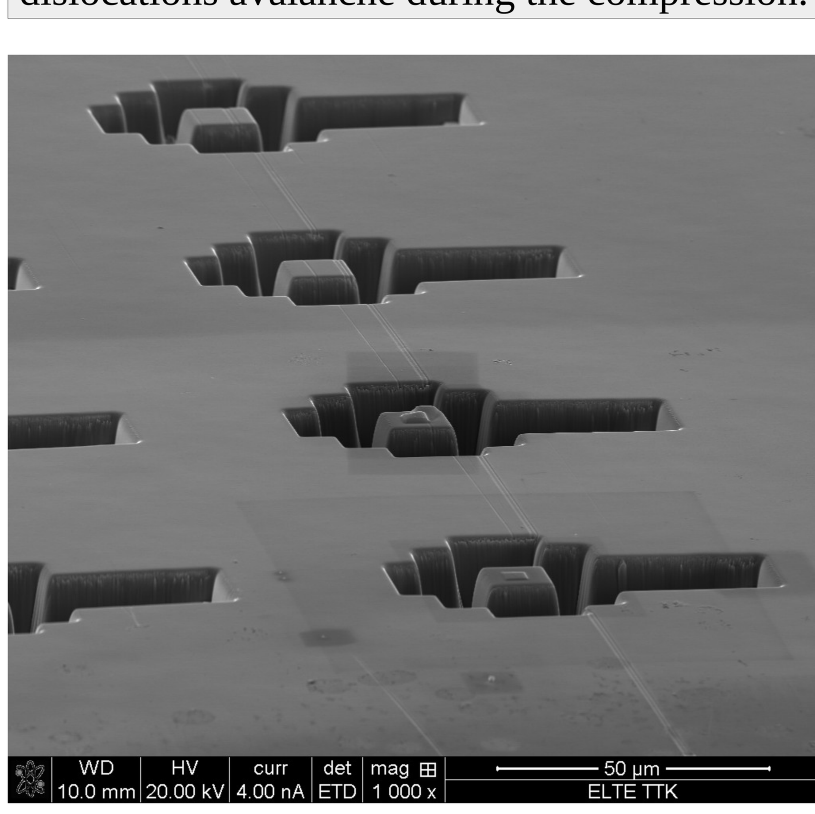
Quanta 3D FEG Dual-beam Scanning Electron Microscope is an apparatus for nanotechnology and advanced materials science. Opens up new dimensions in archaeology, biology, chemistry, earth science, meteorite research, hydrology and many other research areas. Along with „everyday" multidisciplinary use the microscope is a fabrication tool applied to the main core research activites of the Material Physics Department at ELTE, for creating nano- to single-crystalline micropillars and dinamically investigating their deformation.

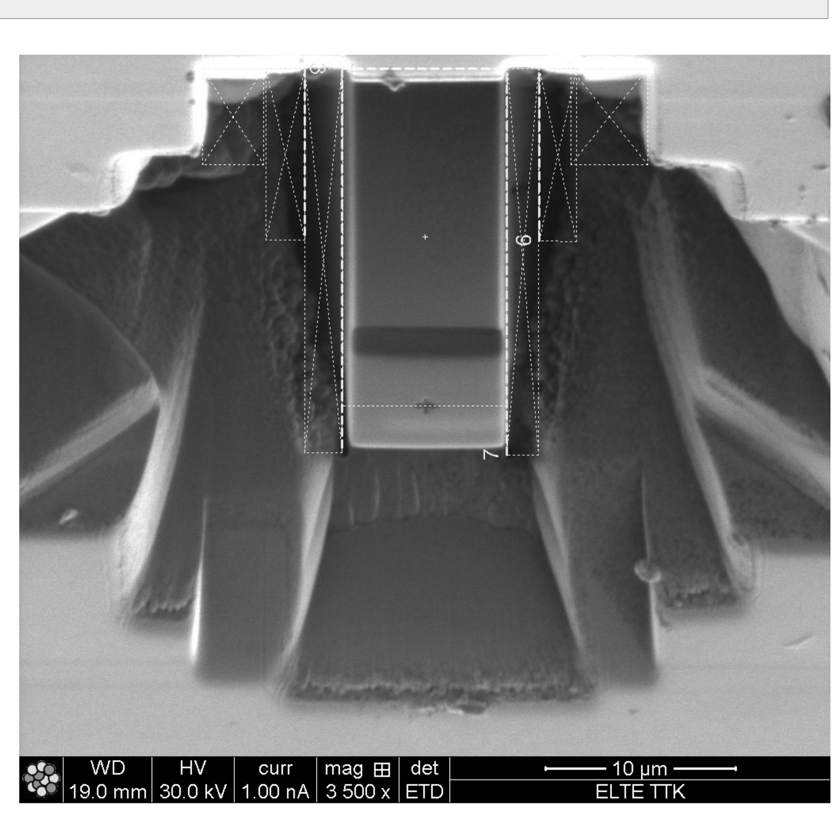
Aims

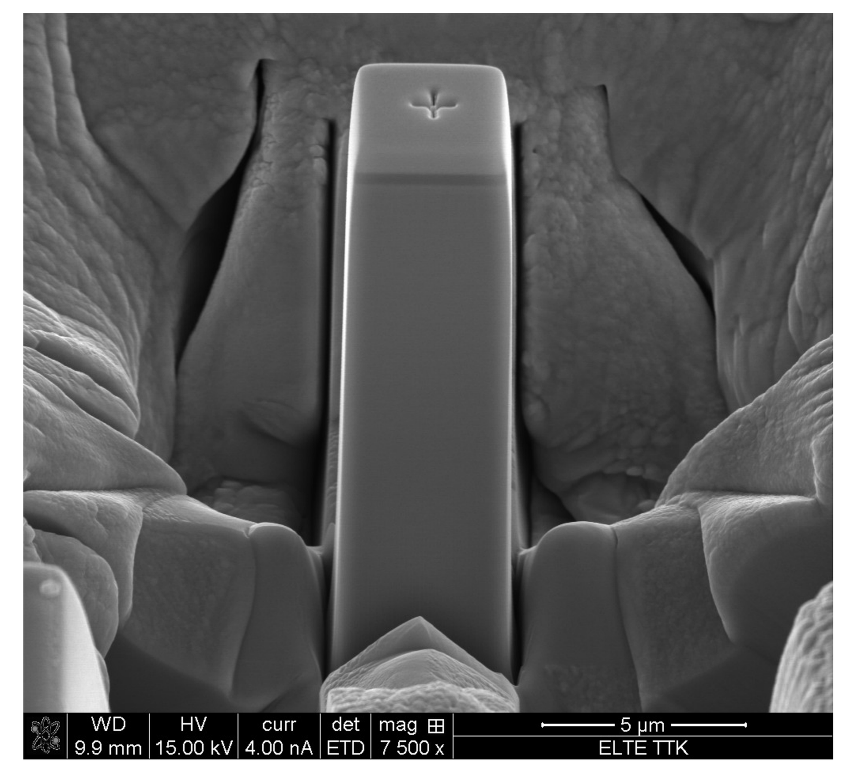
As microscope operators our aim is to create micropillars with the given parameters. We prepare micron sized pillars ready for taking in-situ movies of nanoindentation tests along with recording acoustic emission. That way the research group can measure it's plastical deformation on the micropillars usually caused by the motion of the dislocations.

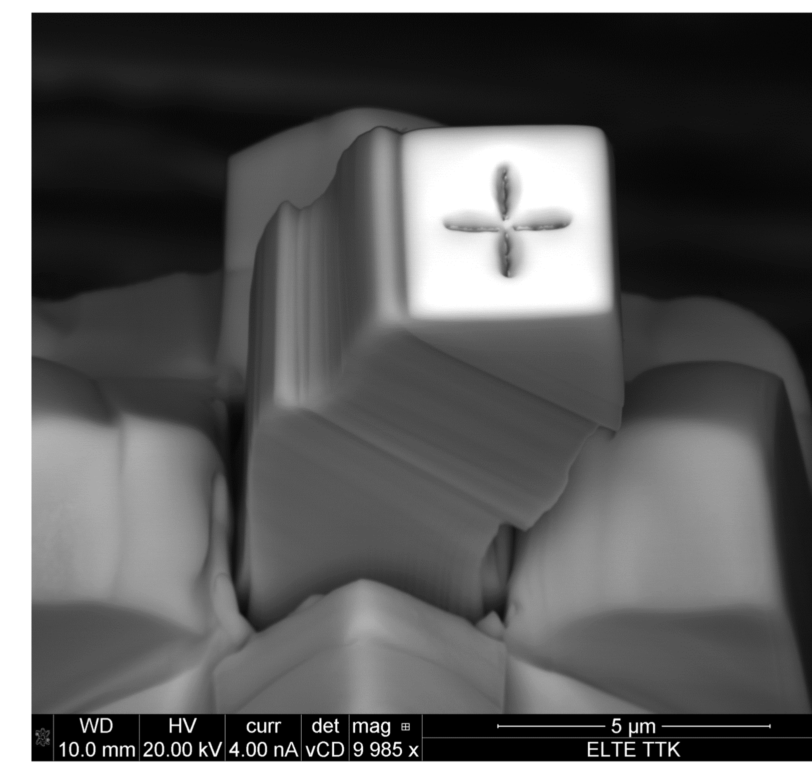
Fabrication Technique

Focused Ion Beam (FIB) milling is a great way to make micro-objects for a selected research. The well prepared, pure Cu single-crystal is mounted in the microscope chamber. A flat surface is a good place to start the milling procedure. We engrave a trench around every pillar using a combained rectangular cross-section (RCS) milling patterns, around a planned a square-base pillar. RCS pattern is a rectangle shape area in which the beam scans paralelly on the whole surface. On the top of every pillar we deposit ~1 μm thick platinum film: injecting Pt content gas close to the sample it absorb on the surface electron or ion beam let the contained platinum lay on the chosen area. We mill a position reference onto the Pt layer. After rough preparation the pillar needs fine shaping of its sides. Decreasing milling currents are used for subsequent shaping and surface cleaning sessions. The final step is to clean the pillar's sides perpendicular to the top with milling pattern parallel to the sides, using the practically smallest current. The pillar's sides become smoother, their shape closer to the flat surface and to visualize the randomly distributed dislocations avalanche during the compression.









Result

Once the pillars height and smoothness is aproppriate they are ready for nanodeformation measurement. The ion milling method provides an efficient way to prepare the micropillars almost exactly in the required, designed shapes. After the procedure is done well-made, unique and uniform, smooth micropillars are ready for measuring their deformation properties.

References:

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