

Micromanipulation in Microscopy: Handling and Characterising Nano Structures

Kleindiek Nanotechnik, Reutlingen, Germany

Scanning Electron Microscopes (SEM), some equipped with additional Focused Ion Beam (FIB) capability, have become essential tools in fabricating and investigating nano structures in a wide range of fields - from semiconductor to materials science, life science, and many more.

Adding micromanipulators to these microscopes' vacuum chambers yields access to another dimension of interaction with nano-sized structures: They allow researchers to touch their samples and thus characterize them in new and exciting ways.

Extended functionality can be achieved by mounting different tool tips to the nanomanipulators. Examples of these are: microgrippers, force sensors, and liquid or gas injectors.

Adding a fourth (rotational) axis to an XYZ-micromanipulator and mounting the microgripper to the end of this assembly yields an 'arm' with a 'wrist' and a 'hand'. This setup allows the researcher to pick up objects, orient them in space, hand them off to another micromanipulator, and place them at the desired location.

Replacing the microgripper with a force sensing unit, provides access to mechanical characterization experiments. Examples for such experiments include tensile tests on nano wires and carbon nano tubes (CNTs), compression tests on super alloy micro cubes, as well as hardness and bending tests on metal flakes or FIB-milled beams.

Switching to ESEM mode and fitting the micromanipulator with a liquid injection system allows the study of liquid surface interactions. One case study presented here compares the behavior of pure water with a solution of 10% glucose in water as they are applied to paper surface.

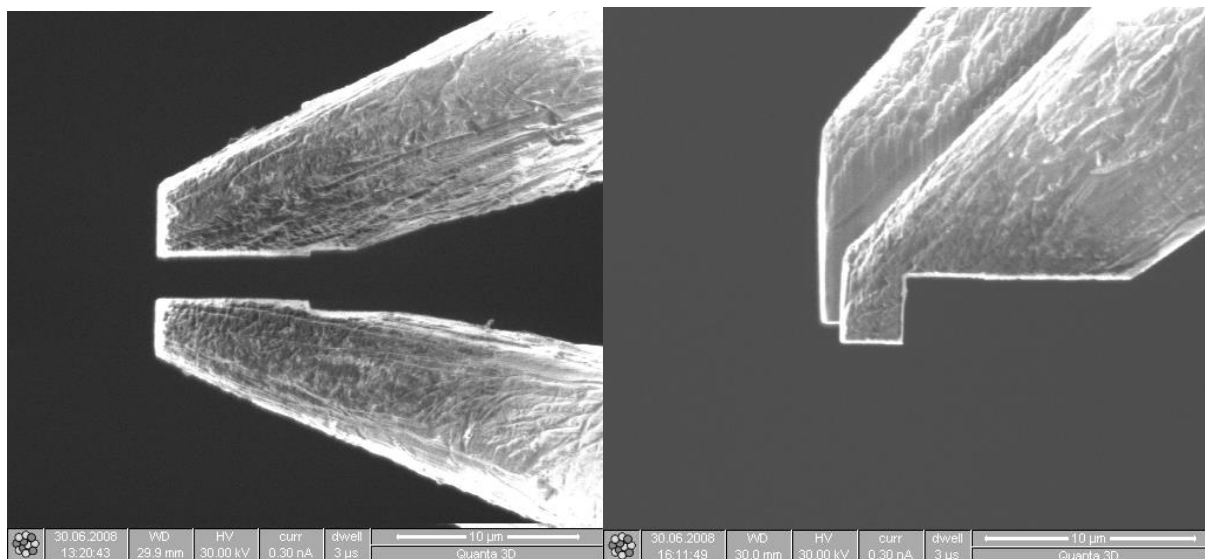


Figure 1. Microgripper attachment for a nanomanipulator. Top view and side view.

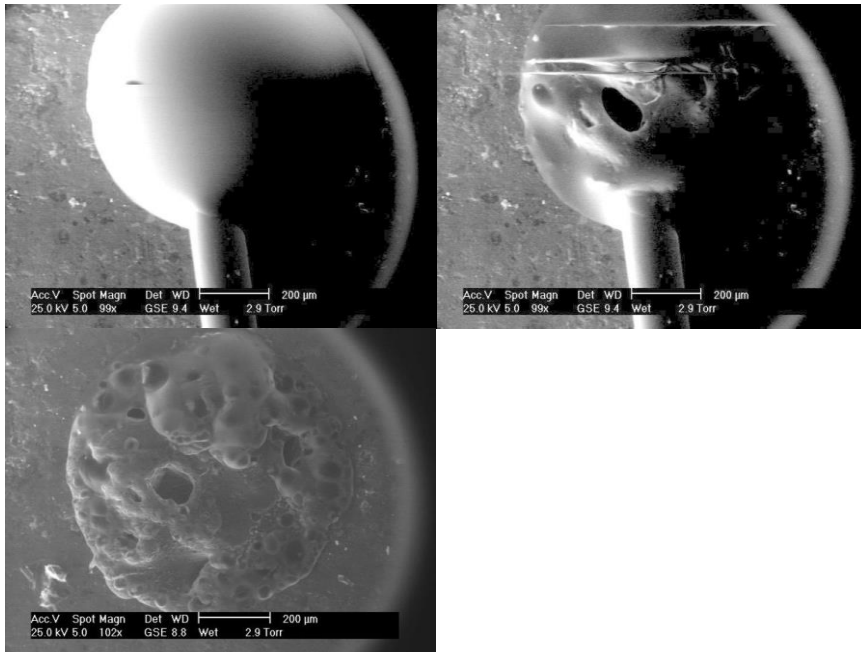


Figure 2. Applying a water droplet to a sugary surface.