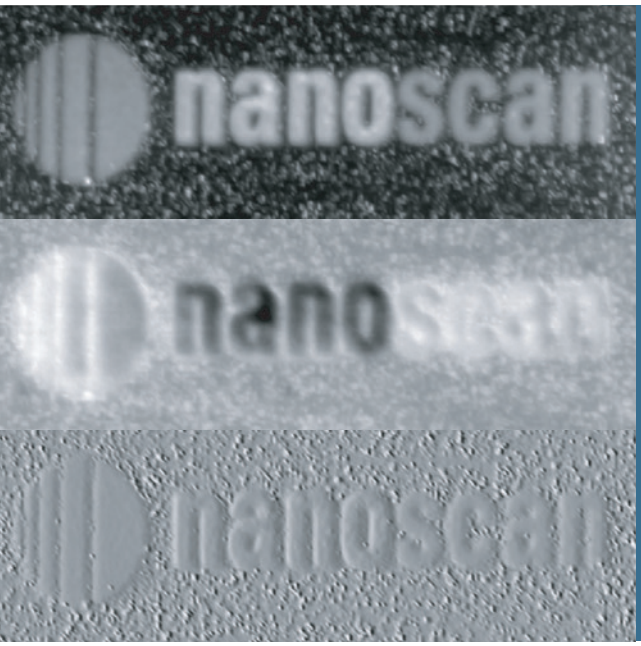
nanoscan

Kelvin Probe Force Microscopy



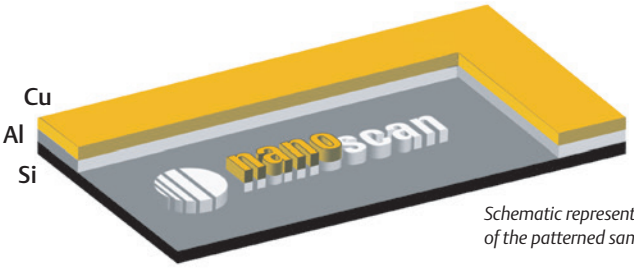
NanoScan VLS-80

Kelvin Probe Force Microscopy is the perfect tool to measure local charging and the contact potential difference between tip and sample. In addition to true topography measurements, it provides complementary information on the work function of the features being imaged.

Kelvin Probe Force Microscopy

Imaging contact potential differences of materials on the nanoscale with millivolt resolution

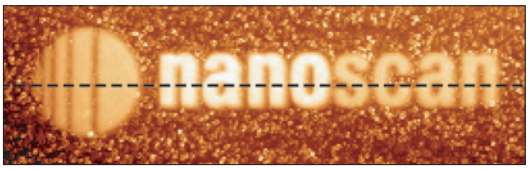
Kelvin Probe Force Microscopy (KPFM) is performed using two fully independent Phase-Locked-Loops (PLLs) of the NanoScan controller, and the dedicated hardware and software. KPFM is the perfect tool to measure local charging and the contact potential difference (CPD) of various surface elements. Compensating for the CPD in realtime is the only method in non-contact AFM to measure the true topography on non-homogeneous surfaces. A sample was prepared such that known topographical features of different metals were present. A silicon substrate was first coated with 30 nm of aluminium, then 20 nm of copper. The logo of NanoScan was then patterned into the surface using using ion-sputtering, leaving distinct parts of the logo in different metals.



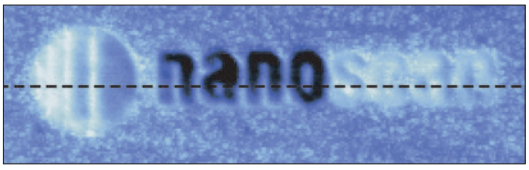
Schematic representation of the patterned sample

Using KPFM, the cantilever is scanned similar to a non-contact AFM image. Simultaneously, a bias voltage is dynamically applied between the tip and the sample at the frequency of the first overtone of the cantilever. This causes the cantilever to oscillate due to capacitive coupling with the surface directly below the tip. The KPFM feedback loop of the NanoScan Controller then continuously adapts the DC bias applied to the cantilever to cancel this electrostatic oscillation. The output of the feedback is the contact potential difference (CPD) or KPFM signal.

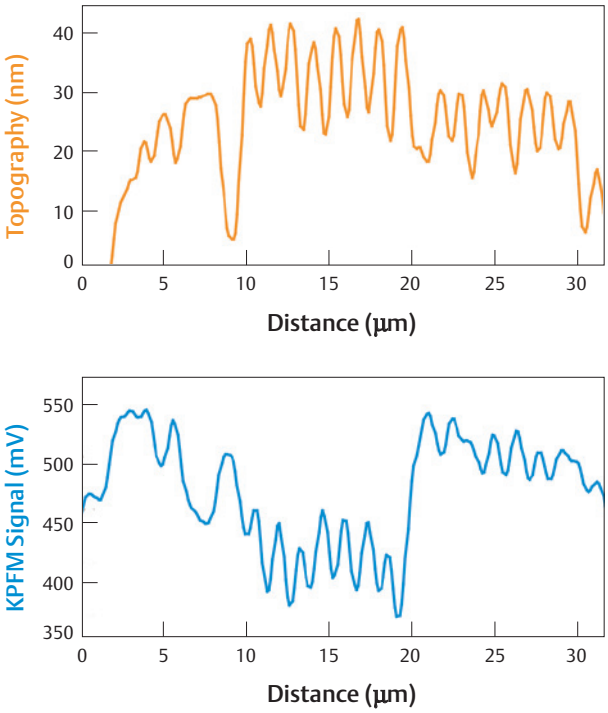
KPFM enables comparative material contrast measurements on conducting and even semiconducting surfaces while accessing true topography.



Non-contact AFM topography image of the logo sample patterned by ion-sputtering. See below profile taken along dotted line. Image size is 32 × 10 µm²



KPFM image, representing the contact potential difference between the tip material and the surface. The image shows clear contrast between copper, aluminium and silicon. Image size is 32 × 10 µm²



Line profiles of topography (orange) and KPFM signal (blue). A clear difference can be seen in the bias potential of copper and aluminium which cannot be attributed to topography.

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