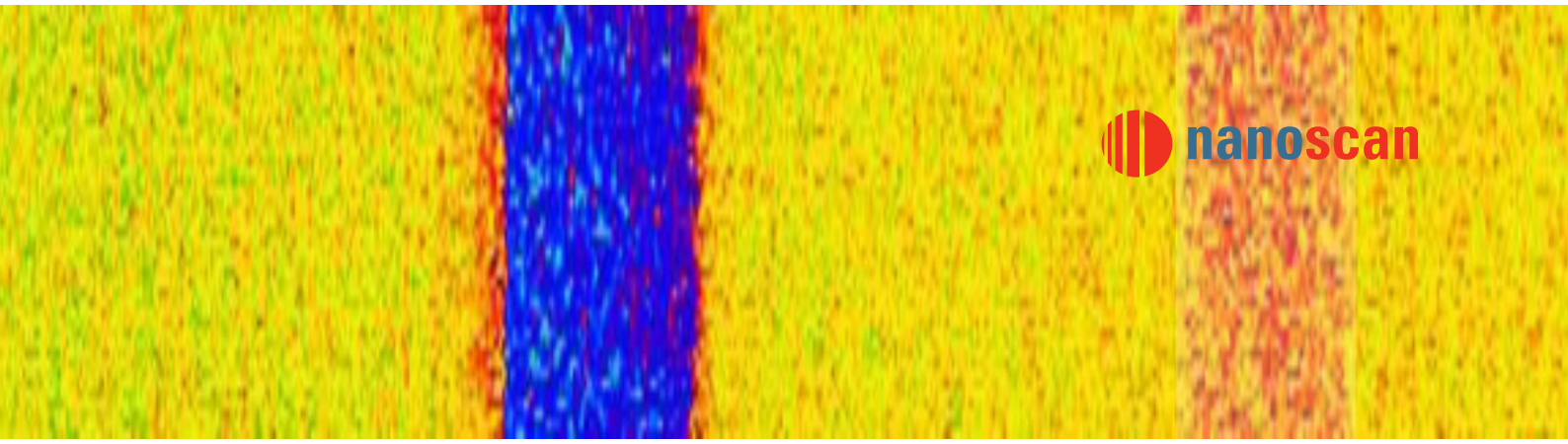
Scanning Thermal Microscopy



VLS^{80} - The tool for thermal imaging at the nanoscale

The generation and flow of heat on the nanoscale has become a critical design parameter in numerous key technologies and is a para-meter of fundamental importance in many electronics devices.

Scanning Thermal Microscopy (SThM) maps the local temperature and thermal conductivity of an interface with excellent spatial resolution giving insights into heat flow at the nanoscale.

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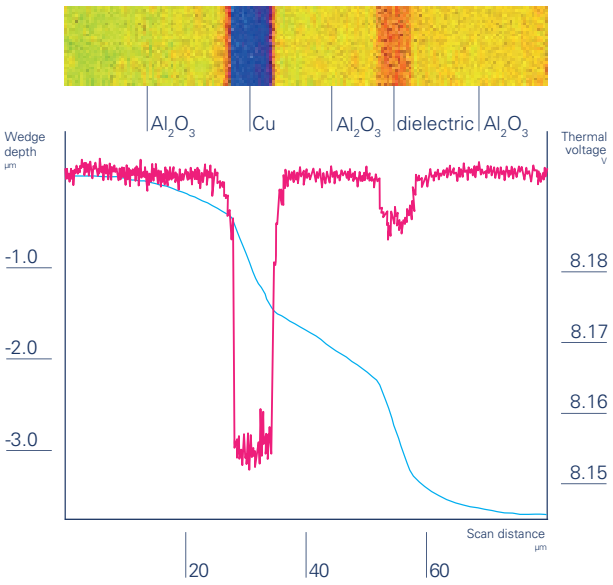
Nanometer scale thermal measurements

The NanoScan VLS[80] enables thermal imaging with nanoscale spatial resolution.
Measuring under vacuum conditions removes thermal transport by convection through air and the formation of a water meniscus around the tip, thereby improving the potential spatial resolution and increasing the sensitivity to the thermal properties of the sample.
Thermally resistive probes consist of a lithographically fabricated palladium resistance thermometer whose resistance is proportional to its temperature. Hence by passing a small current through the tip and monitoring the voltage across it, the temperature of the tip can be measured. This current also heats the tip through Joule heating and when the tip approaches the sample surface it cools via heat transport through the sample. The resultant tip temperature is therefore not just a measurement of the surface temperature of the sample, but also the thermal transport parameters in the sample such as its thermal conductivity.



For this application example a wedge crater under a shallow angle was ion milled into a sample with five alternating multi-layers of 1 µm thickness each. After preparation the sample was transferred into the VLS[80] vacuum chamber. Navigation to the wedge using the video image of the sample was easily achieved.
The graph shows the thermal scan of the crater side wall revealing the thermal properties of all the layers.
The thermal image (top) shows the temperature contrast across the layers showing coolest (darkest) for the Cu with the highest thermal conductivity, followed by a dielectric and Al_2O_3.
The thermal voltage is averaged along the y-axis to generate the scanning thermal microscopy profile shown.