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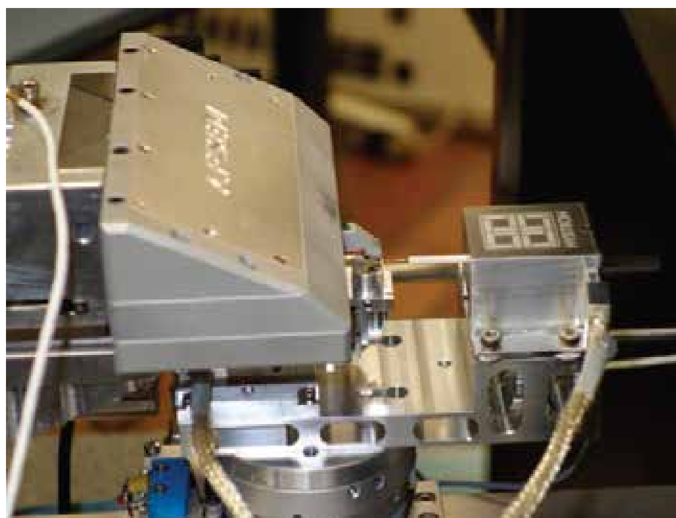
A QUANTUM DESIGN COMPANY

Application Note:
Nanoindentation Analysis with AFSEM®
Observe the Indentation by SEM, Measure It with AFSEM

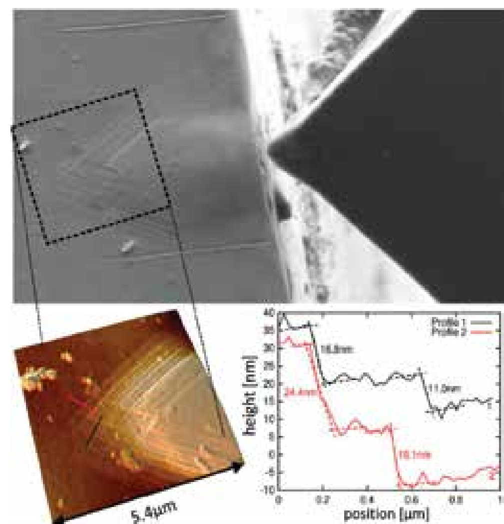
SEM is widely used to study the surface structure after nanoindentation. The combination of a large field of view with nanometer resolution allows detecting early stages of crack formation, slip steps, and other surface defects indicating the onset of material surface failure. However, quantitative height information is not available in an SEM. AFM is an established tool for quantitative analysis of nanoindents, but generally lacks larger screening capabilities.

With AFSEM, SEM and AFM can be combined with nanoindentors for correlative, in situ analysis of nanoindents. Its tip scanner does not interfere with the use of specialized SEM stages, like a nano-indenter. Consequently, nanoindentation can be used interactively with SEM and AFM imaging, performing multiple indentations with in-between analysis, without the necessity to vent the SEM and take out the sample for each indentation/analysis cycle.

The SEM can be used for guiding both the indenter and the AFM. After nanoindentation from the side, slip step analysis can be carried out with SEM and AFM in situ. The SEM provides information over the progression of the slip step area and the AFM quantification of slip step heights.



SEM equipped with a nanoindenter and AFSEM



Correlative AFM and SEM analysis after nano-indentaion. Data courtesy: Josef Kreith & Megan Cordill, Erich Schmid Institute of Material Science, Leoben

In summary, AFSEM is the solution of choice to obtain overview information of even the smallest surface alterations and quantitative data on crack depths, slip step heights, or the pile up or sink in volume around an indent in a single instrument. For analysis of the indentation face, multi-axis flip stages are on the market that rotate the sample after indentation, further extending the possibilities of correlative AFM-SEM.

Details of this study can be found in article “A versatile atomic force microscope integrated with a scanning electron microscope” found in Review of Scientific Instruments 88, 053704 (2017).