A Highly Integrated Correlative Microscopy Platform

K.T. Arat, A. Alipour, H. Alemansour, A. Amann, J. Diederichs, L. Montes, B. Colvin, J. Gardiner, W.K. Niels, S. Spagna
Quantum Design Inc., 10307 Pacific Center Ct., San Diego, CA 92121
karat@qdusa.com

C.H. Schwalb, H. Frerichs, S. Seibert, L. Stühn, M. Wolff
Quantum Design Microscopy GmbH, Breitwieserweg 9, 64319 Pfungstadt, Germany

There is growing interest in in-situ correlative microscopy promising to eliminate the complications that arise from sample transfer [1]. However, challenges regarding the determination of the region of interest within the system remain, unless the coordinate systems of these techniques are truly unified for a seamless correlation. Here, we introduce a novel correlative microscopy platform, the FusionScope, which integrates Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) with its unified coordinate system [2].

The platform's base version integrates a state-of-the-art AFM based on self-sensing cantilever technology, a compact SEM column with a Schottky electron source providing high-resolution imaging, a combined three-axis stage and AFM scan head on an up-to-80-degree-tilt-capable trunnion providing unparalleled experimental capabilities such as Profile View, as demonstrated in **Error! Reference source not found.**.

The FusionScope allows for easy expansion of its capabilities, such as elemental analysis via Energy Dispersive X-ray Spectroscopy (EDS), or adding nano-manipulating and nano-probing capabilities. The rich set of AFM modes (Contact, Dynamic, FIRE, Conductive, Magnetic, and Electrostatic) allows for the extraction of a multitude of sample properties.

The unified coordinate system serves as the keystone of the platform, enabling a truly correlated user experience in which all operations take place on the same exact coordinates of the sample. It simplifies the difficulties of guiding the AFM tip to the desired region, even on challenging 3D topographies such as the tip of a Schottky electron source used in SEMs (Figure 2).

In essence, the FusionScope is the first truly integrated AFM and SEM that serves the emergent field of correlative microscopy. Combining these two microscopy techniques, in-situ, into a highly integrated workstation opens unprecedented measurement capabilities at the nanoscale while simplifying experiment workflows to yield a higher level of data throughput.

[1] [1] Smith, C. Two microscopes are better than one. Nature 492, 293–297 (2012). doi.org/10.1038/492293a

[2] A Alipour, A Highly Integrated AFM-SEM Correlative Analysis Platform, *Microscopy Today*, Volume 31, Issue 6, November 2023, Pages 17–22, doi.org/10.1093/mictod/qaad083

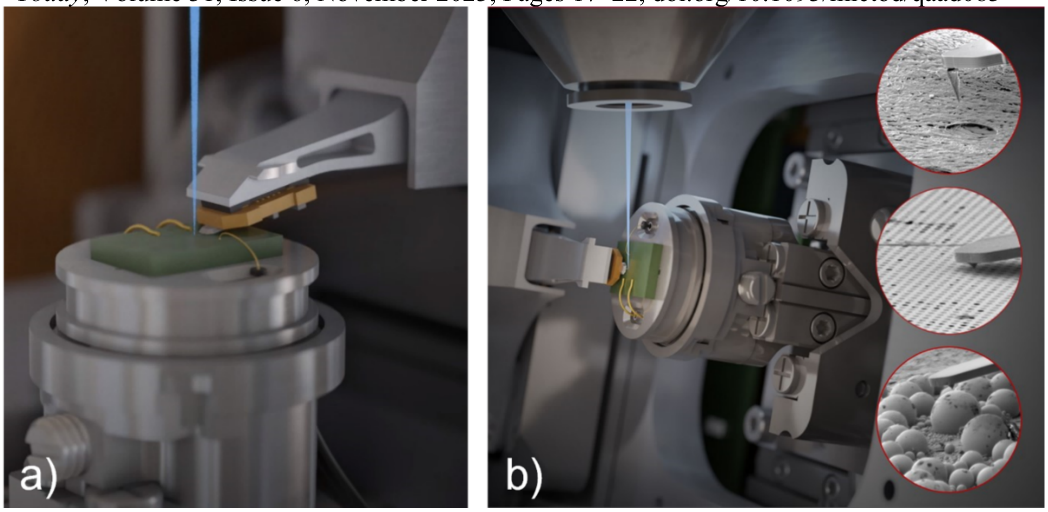

Figure 1 – Illustration of the Profile View: a) zero and b) eighty-degree trunnion tilt configurations. With an eighty-degree tilt, it is possible to accurately monitor the operation of the AFM tip on regions of interest, even on complex and challenging samples. Insets are SEM images in Profile View mode with different samples and cantilevers.

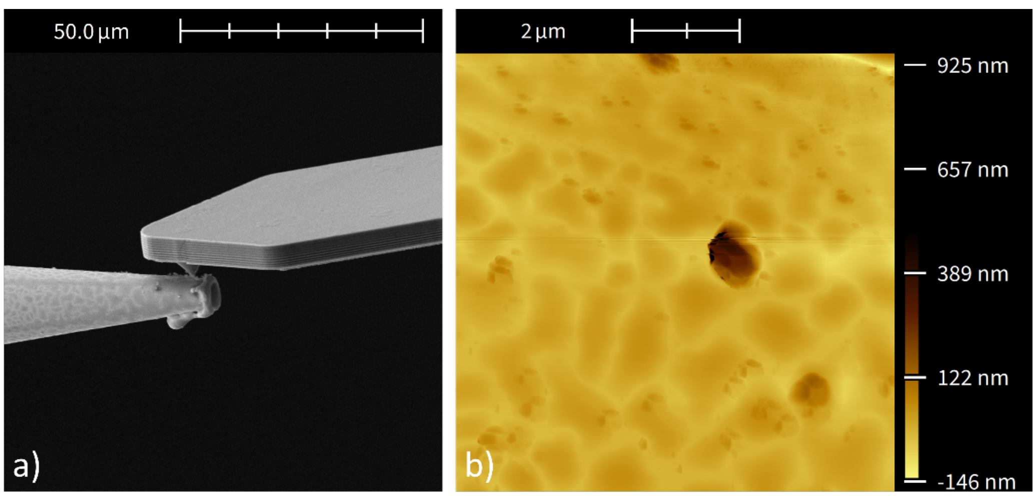

Figure 2 – Landing of AFM Tip on an Electron Source: a) SEM Image of an engaged AFM tip on the tip of an electron source in Profile View mode (80° tilt) b) AFM scan reveals the details of the surface topography. The color scale of the AFM image is inverted, and the contrast is saturated at the high side (down to 500 nm) for the sake of visibility of the "vein-like" structure on the surface. The typical depth of these structures is ~50 nm.