

# A near-field scanning microwave microscope in a scanning electron microscope: design and challenges.

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We present a Scanning Electron and Microwave Microscopy (SEMM) that is a combination of complementary microscopy techniques. The SEMM namely combines Atomic Force Microscopy (AFM), Scanning Electron Microscopy and Vector Network Analysis (VNA). Combination of multiple modes allows cross correlation of imaging techniques that may be useful for investigating materials at the nanoscale [1]. First, the high-resolution SEM provides precise positioning of the AFM tip on the sample and gives feedback on the tip shape and degradation with scanning. Second, the AFM gives topography images of the surface with sub-nanometric resolution. Third, while AFM scanning, the microwave signal from VNA propagates to the sample surface, is partially reflected by the material, and gives rise to a reflected amplitude and phase depending of the nanoscale electrical microwave properties of the material. The combination of AFM, SEM and RF requires optimization of each technique considering the others. As for SEM, it is necessary to limit the surface exposure to the electron beam to avoid parasitic charging with electrons. Vacuum environment for AFM requires remote control of all mobile parts including laser and optical detection alignment. The simultaneous VNA imaging should use a proper triggering.

The AFM is designed to be compatible with the SEM chamber size and environment. SmarAct positioners are used for the optical system adjustment as well as for remote alignment of AFM X,Y,Z sample scanner within the SEM (Fig. 1.). A calibration kit based on MIS capacitances is imaged to validate the measurement resolution of the SEMM.

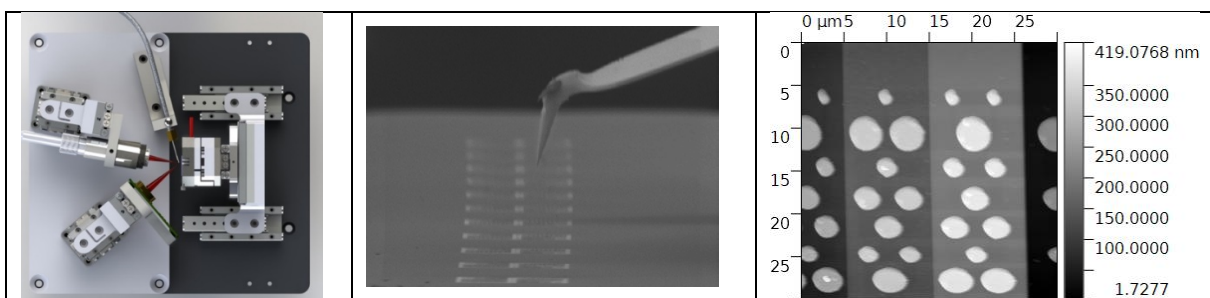


Fig. 1. Top view of AFM (the left image), SEM image of the tip and calibration sample surface (the middle image), and AFM topography image of the sample surface (the right image)

[1] O. C. Haenssler et al., Journal of Vacuum Science & Technology B 36 (2), 022901 (2018)

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