ULTIMATE NANOPROBING IN UHV: FOUR INDEPENDENT SCANNING TUNNELING MICROSCOPES NAVIGATED BY HIGH RESOLUTION UHV SEM

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A major challenge in Nanotechnology is the incorporation of single nano-devices into larger integrated circuits. Device technology research requires high resolution topographical and chemical analysis with well established experimental techniques or electrical characterisation using standard probing systems.

Traditional instrumentation suffers from one fundamental issue: How to cover the dimensional range of a fully integrated circuit down to the nanometer range (or even atomic scale) of single devices and have an adequate integrated navigation system. To meet these requirements, we have established and being advancing a new approach to integrating state-of-the-art SPM technology via high resolution electron microscopy and spectroscopy: (1) Bridging dimensions and rapid navigation; (2) Combining different surface analysis methods at the very same sample area to gain complementary information; (3) Integrated position-readout of sample and probe positioning; (4) Pushing each single technology to its inherent limits.

The system facilitates four independent Scanning Tunnelling Microscopes and the UHV version of the Zeiss Gemini SEM column with ultimate resolution below 4nm for probe navigation and rapid localisation of sample features or devices. STM imaging is used to pro-actively position and contact the probe(s) on nano-devices. Using STM probe approach technology, a controlled electrical contact is ensured to finally perform a four-point measurement on the nano-scale.

Beyond navigation, SEM enables different electron spectroscopy methods to gain magnetic or chemical information on the sample area. Using SEMPA (SEM with polarization analysis) magnetic domain imaging with a resolution in the 10nm range is achieved to allow for correlation of transport properties and domain distribution. Using SAM (Scanning Auger Microscopy) chemical mapping can be achieved with 10nm resolution to correlate transport properties and material composition. Various application examples will be shown to illustrate the system capabilities.