In-Situ Correlative AFM/SEM/FIB analysis ion-beam treated samples

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The combination of different microscopic and spectroscopic methods into one instrument gained increasing importance due to the simultaneous acquisition of complementary information. Especially highly localized probing of mechanical, electrical, chemical and crystallographic properties on the nanoscale represents a key success factor for gaining new insights in the micro and nano world.

We present a unique atomic force microscope (AFM) – the AFSEM™ - designed for seamless integration into scanning electron microscopes (SEM) or FIB systems. Its open design and the use of self-sensing cantilevers with electrical readout allows for simultaneous operation of SEM, FIB and AFM inside the vacuum chamber to perform correlative in-situ AFM/SEM/FIB analysis of ion-beam treated nanostructured materials. For the first time, we present correlative AFM/EBSD data of a FIB polished ZrO₂ ceramic of phase transformed regions. While EBSD allows for locally identifying areas where the phase transformation has occurred, in-situ AFM can now be utilized to analyze phase-transformation-induced topographic changes with sub-nm resolution. In a further step, we demonstrate how in-situ correlative analysis with the AFSEM™ in an SEM can be extended into the third dimension to measure nanomechanical properties of soft material. To achieve this, FIB slicing and mapping of nanomechanical properties using the AFSEM™ is performed in repetitive steps to build up a 3-dimensional elasticity map. Finally, we present for the first time in-situ correlative AFM results of helium treated surfaces inside the Zeiss ORION Nanofab.