NanoScale 2019

Helmholtz-Fonds e. V.

Scope of the Seminar

The NanoScale seminar will stimulate the exchange of experiences between researchers, industrial users and metrologists in the fields of optical, electron, and scanning probe microscopy as well as related techniques, to solve daily measurement challenges in the micro- and nano-world.
The accurate determination of geometrical and other physical properties of micro- and nano-structures is essential not only for research and development, but increasingly also a prerequisite in process control and quality assurance in a broad range of industries from ultra-precision manufacturing to nano-biology and medicine. Changes of physical properties are correlated to the size of structures, too. This requires stable instruments with high resolution and small measurement uncertainty.
Furthermore, areal-based measurements become more and more important against single profile-based techniques and are often indispensable to determine the surface topography and extract those parameters that are vital for the assessment of the sample's functional properties. Increasingly, other properties than just topography need to be measured. Therefore, new techniques or combinations of methods are necessary.
New methods suitable for the investigation at the nanoscale need to be evaluated and thoroughly tested. The specification, characterization and calibration of instruments requires well elaborated, generally agreed and accepted uniform standardized procedures. Such rules are to be defined and agreed in national and international committees.
Finally, measurements result in a quantitative number and unit describing a geometrical or physical property. This has to be combined with the measurement uncertainty, determined by using an appropriate measurement uncertainty budget, to achieve a traceable result and ensure comparability over long time and, whenever possible, across methods – a particularly challenging task in nanometrology.

Topics to be addressed

Instrumentation and methods

Advances in instrumentation such as repeatable probe/sample positioning, position-measuring systems, linearization methods, high-speed, low force, novel/improved probe/detector systems, novel 3D probing concepts, probe-sample interaction image processing, as well as modelling and simulation techniques. A few examples:

- High-resolution optical microscopy (phase-shift, confocal, white-light, holographic, focus variation, and chromatic confocal microscopy) and light scattering including simulation
- Interferometry to measure the displacement of stages or to determine the shape of small features in the micro range
- Atomic Force Microscopy (AFM) including simulation
- Further Scanning Probe Microscopy (SPM) techniques, e.g. STM, SKFM
- High-resolution, low force tactile instruments for profile or areal measurement
- Electron Microscopies (SEM, TSEM, TEM, STEM)
- Hybrid instruments combining different measurement techniques and exploiting different physical interactions for holistic sample characterization

Calibration & correction methods

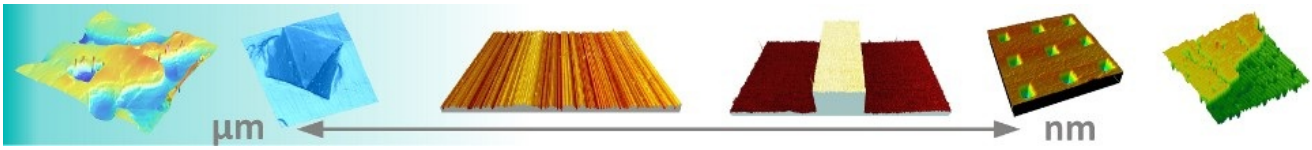
The specification of instruments is a prerequisite for any accurate and traceable measurements.

- Setup of instruments and the definition of the metrology specification
- Development of documentary standards and material measures (transfer standards) for the characterization and calibration of instruments, especially for the specification of probe shape (tip or optic)
- Recipes for stitching of measured images and fusion of data obtained from different measurement heads/instruments, 3D reconstruction techniques, etc.
- Evaluation of the measurement uncertainty for more complex measurement tasks
- Review of accomplished comparisons, extraction of the needs for further comparisons

Applications

Quantitative measurements and measurement applications in fields like

- Geometry of micro- or nano-objects (height, width, film thickness, line width, form, profile and areal surface roughness, etc.)
- Relationships of surface topography parameters and functional behavior, correlation of dimensional and other physical properties
- Complex parameters for friction and tribology
- Measurement of complex structures, e. g. in micro-systems/-electronics, nano/quantum/molecular electronics and other devices, incl. applications in biology and medicine
- Exchange on measurement needs among the various stakeholders, required uncertainties in different application fields, better understanding of future needs



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