

1. Record Nr.	UNINA9910144578403321
Titolo	Nanoscale calibration standards and methods [[electronic resource] ] : dimensional and related measurements in the micro- and nanometer range // edited by Gunter Wilkening, Ludger Koenders
Pubbl/distr/stampa	Weinheim ; ; [Chichester?], : Wiley-VCH, c2005
ISBN	1-280-85401-4 9786610854011 3-527-60666-1 3-527-60687-4
Descrizione fisica	1 online resource (543 p.)
Altri autori (Persone)	KoendersLudger WilkeningGunter
Disciplina	620.50287
Soggetti	Microstructure - Measurement Nanostructured materials - Measurement Scientific apparatus and instruments - Calibration Stereology Electronic books.
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Conference proceedings.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Nanoscale Calibration Standards and Methods; Contents; List of Contributors; Part I Instrumentation - Overview; 1 Metrological Scanning Probe Microscopes - Instruments for Dimensional Nanometrology; 1.1 Introduction; 1.2 High-Resolution Probing Systems; 1.2.1 Sensor Objective with Beam Deflection Detection; 1.2.2 Sensor Objective with Piezolever Module; 1.2.3 Sensor Objective with Tuning Fork Module; 1.2.4 Sensor Head for Combined Scanning Probe and Interference Microscopy; 1.3 Metrology Systems Based on Scanning Probe Microscopes; 1.3.1 Scanning Force Microscopes of Type Veritekt 1.3.2 Metrological Large Range Scanning Force Microscope1.4 Summary; Acknowledgments; References; 2 Nanometrology at the IMGC; 2.1 Introduction; 2.2 Surface Metrology; 2.2.1 Scanning Probe Microscopy; 2.2.2 Optical Diffractometry; 2.2.3 Stylus Profilometry; 2.3 Atomic Scale Metrology; 2.3.1 Lattice Parameter of Silicon; 2.3.2

Combined Optical and X-Ray Interferometry (COXI); 2.4 Phase-Contrast Topography; 2.4.1 Detection of Small Lattice Strain; 2.4.2 Phase-Contrast Imaging; 2.5 Nanobalance; 2.6 Conclusions; References; 3 Metrological Applications of X-ray Interferometry; 3.1 Introduction 3.2 Measurement of Non-linearity in Optical Interferometers 3.3 Combined Optical and X-ray Interferometry; 3.4 Measurement of Small Angles; 3.5 X-ray Interferometry and Scanning Probe Microscopy; 3.6 Conclusions; References; Part II Instrumentation - Long-range Scanning Probe Microscopes; 4 Advances in Traceable Nanometrology with the Nanopositioning and Nanomeasuring Machine; 4.1 Introduction; 4.2 Design and Operation; 4.3 Uncertainty Budget; 4.4 Focus Sensor; 4.5 Measuring Opportunities and Performance with Focus Sensor; 4.6 Focus Probe with SFM Cantilever; 4.7 Conclusion; Acknowledgements References 5 Coordinate Measurements in Microsystems by Using AFM-Probing: Problems and Solutions; 5.1 Introduction; 5.2 Realizing CMMs for Microsystems; 5.3 Problems and Solutions; 5.3.1 Dynamics of Positioning System; 5.3.2 CMM: One-Millimeter Scan; 5.3.3 Measuring Strategies; 5.4 Conclusion and Outlook; References; 6 Metrological Large Range Scanning Force Microscope Applicable for Traceable Calibration of Surface Textures; 6.1 Introduction; 6.2 Instrumentation; 6.2.1 Principle; 6.2.2 Metrological Properties; 6.2.3 Traceability; 6.2.4 Specially Designed Features 6.3 Measurement Result of a 2D-Grating Standard 6.3.1 Measurement Strategy; 6.3.2 Data Evaluation; 6.3.3 Measurement Result of the Mean Pitch Value; 6.3.4 Measurement of the Local Pitch Variation; 6.4 A Selected Measurement Result of a Microroughness Standard; 6.4.1 Measurement Result of a Glass Flatness Standard; 6.4.2 Measurement of a PTB Microroughness Standard; 6.4.3 Comparison of the Roughness Measurement Results Derived from SFM and Stylus Instruments Using Gaussian Filter; 6.4.4 Comparison Using Morphological Filters; 6.4.5 Evaluation Results Using PTB Reference Software 6.5 Outlook and Conclusion

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## Sommario/riassunto

The quantitative determination of the properties of micro- and nanostructures is essential in research and development. It is also a prerequisite in process control and quality assurance in industry. The knowledge of the geometrical dimensions of structures in most cases is the base, to which other physical and chemical properties are linked. Quantitative measurements require reliable and stable instruments, suitable measurement procedures as well as appropriate calibration artefacts and methods. The seminar "NanoScale 2004" (6th Seminar on Quantitative Microscopy and 2nd Seminar on Nanoscal

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