Optical metrology at the nanoscale

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Nanotechnology is one of today's key technologies, enabling a wide range of applications. The most prominent example of the ongoing trend towards further miniaturization is undoubtedly optical lithography, which is used to manufacture highly integrated circuits and leading-edge microchips. The advances in nanotechnology are closely related to the progress in nanometrology. As with any technology, reliable processes and mass production are only possible if structures and objects can be measured with a high degree of reliability and if traceability is provided. In general, nanometrology involves all the structural, chemical, electronic or optical properties of a nanostructure. A structure or object is said to be nanoscale if it is between one and 100 nanometers in at least one dimension. This contribution presents three optical methods related to the structural and dimensional characterization of features or objects at the nanoscale. In particular, we discuss advanced model-based optical scatterometry, absolute interferometric measurements of structuring errors in computer-generated holograms and explore new concepts for 3D nanometrology over a large measurement volume of 200 mm × 200 mm × 25 mm using the capabilities of the Nanopositioning and Nanomeasuring Machine (NPMM-200) installed at ITO.

Short biography:

Stephan Reichelt received his Ph.D. in interferometric testing of aspherical optics and computer-generated holograms from the University of Stuttgart, Germany, in 2004. From 2003 to 2006, he was a postdoctoral researcher at the Microoptics Laboratory, Department of Microsystems Engineering (IMTEK), University of Freiburg (Germany), where his interests included biomedical imaging and physiological sensing, as well as the design, fabrication and testing of micro-optical elements and systems.
From 2007 to 2021 he worked in the optical industry in Germany and Switzerland developing 3D holographic display solutions and customized high-precision OEM products for the semiconductor, metrology, medical and general photonics markets. Since October 2021 he is full professor at the University of Stuttgart and director of the Institute of Applied Optics (ITO). He has authored or co-authored more than 60 technical publications in the areas of optical design and metrology, biomedical sensing and imaging, and 3D holographic imaging and visual perception. He holds several patents. His current research focuses on optical metrology, inspection and sensing for industrial and biomedical applications. He is a member of OPTICA, SPIE, the European Optical Society (EOS) and the German Society for Applied Optics (DGaO).