engineering proceedings

Abstract

Development of a Metrological Atomic Force Microscope System with Improved Signal Quality †

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† Presented at the 8th International Symposium on Sensor Science, 17–28 May 2021; Available online: https://i3s2021dresden.sciforum.net/.

Abstract: This article presents a new metrological atomic force microscope (MAFM) with a homodyne interferometer and a tilt measuring system by a position sensitive device (PSD). The combination allows simultaneous three-dimensional detection of the tip displacement by capturing the position, bending and torsion of a reflecting surface of the cantilever realized with one laser beam. Based on an existing interferometric measuring head of a micro-tactile 3D probe, the sensor head was revised and adapted for atomic force microscopy. The new measuring system uses two tiltable plane mirrors to adjust the direction and position of a focused laser beam. With this adjustment unit, the focused laser beam can be steered perpendicular to the reflecting backside of the cantilever. Regarding the probe system, the optical design of the measuring head has been reengineered to reduce the disturbing interference on the PSD. A simulation applying the optical design program OpticStudio from Zemax shows that the integration of two wedge plates with a wedge angle of 0.5° reduces the disturbing interference significantly. After manufacturing, initial measurement results are presented to verify the functionality.

Keywords: metrological atomic force microscope (MAFM); tiltable plane mirrors; reduced disturbing interference

Citation: Wu, Y.; Wirthmann, E.; Klöpzig, U.; Hausotte, T. Development of a Metrological Atomic Force Microscope System with Improved Signal Quality. *Eng. Proc.* **2021**, *6*, 49. https://doi.org/10.3390/I3S2021Dresden-10102

Academic Editors: Gianaurelio Cuniberti and Larysa Baraban

Published: 17 May 2021

Supplementary Materials: The presentation file is available at https://www.mdpi.com/article/10.3390/I3S2021Dresden-10102/s1.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data are available upon request.

Acknowledgments: The authors thank the European Metrology Programme for Innovation and Research (EMPIR) for funding the project "Traceable three-dimensional nanometrology (3DNano)". The authors also thank all those colleagues at the FAU for their contributions to these presented developments. Last but not least, the authors want to thank the G. Dai and J. Flügge from Physikalisch-Technische Bundesanstalt (PTB) for their cooperation.