Development of a metrological atomic force microscope system with improved signal quality

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Abstract: This article presents a new metrological atomic force microscope (MAFM) with a homodyne interferometer and a tilt measuring system by position sensitive device (PSD). The combination allows the 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 detection head of a micro-tactile 3D probe [1], the sensor head was revised and adapted for atomic force microscopy. The new measuring system uses two tiltable plane mirrors to adjust 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

References:

[1] F.G. Balzer, T. Hausotte, N. Dorozhovets, E. Manske, G. Jäger, Tactile 3D microprobe system with exchangeable styli, Measurement Science and Technology, 094018 (2011); doi:10.1088/0957-0233/22/9/094018.