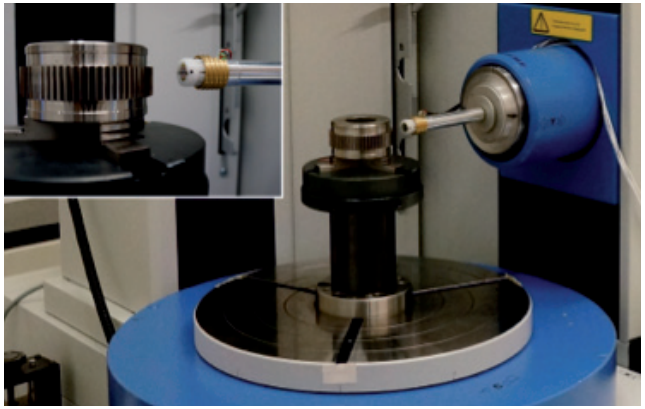
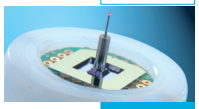
Gear measurements

The 3D microprobe is quantified on a small reference sphere (e. g. ∅ 2 mm). In the course of the quantification, a large number of equally distributed points are probed on the reference hemisphere facing the probe. This process allows the electrical signals to be exactly converted into probe deflections and also permits to obtain a precise description of the mechanical 3D behaviour. The determined parameters are stored in the control system of the measuring instrument and used for the subsequent measuring routines.



Gear measurement with the microprobe

For a first validation of the new micro probing system, measurements have been carried out on a calibrated spur gear measurement standard (module 1 mm). With deviations smaller than 0.4 µm, the slope, form and total deviations for profile and helix show a very good agreement with the calibration values.



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5.33 | Gear and Thread

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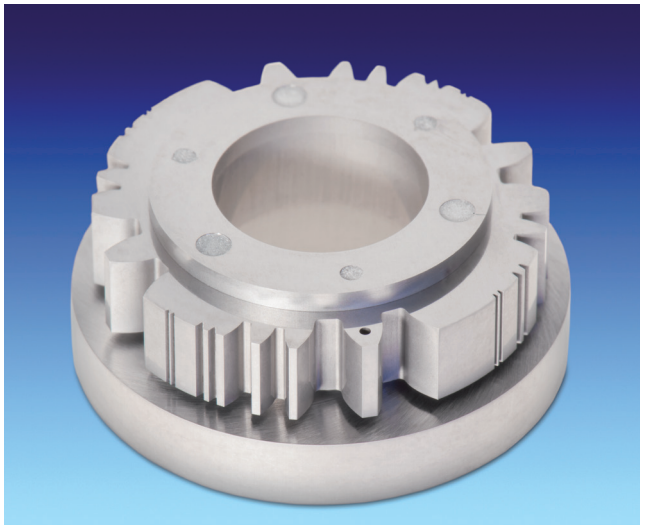
PTB

Microprobe for Gear Metrology

Motivation

Micro gears with transverse modules between 0.1 mm and 1 mm have become an indispensible part of modern production. They are used in medical devices, in semi-conductor manufacture, microrobotics, and precision engineering and are, thus, gaining in economic relevance. For these gears, a minimum of material and simultaneous a maximum of precision and efficiency are required. For the implementation of these requirements, a reliable measurement technology is indispensable.



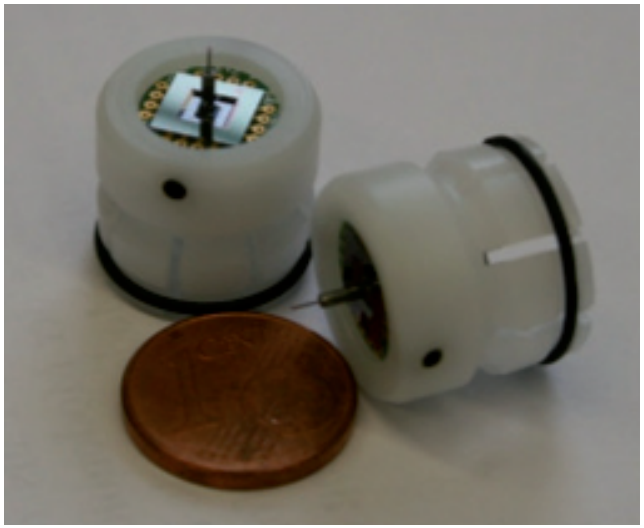
PTB-developed product-like micro gear measurement standard (tip diameter 20 mm, module 0.1 to 1 mm)

The PTB and the Institute of Microtechnology (IMT) of the Technische Universität Braunschweig have now developed a micro probing system which can be integrated into gear measuring instruments[1]. It features probe tip diameters below 300 µm to make measurements of microstructures possible. In future, the field of application of the new micro probing systems can also be extended to other measuring instruments and other measurement tasks.

[1] *The activities were carried out within the scope of a project funded by the Deutsche Forschungsgemeinschaft (DFG).*

Microprobes

Gear measuring instruments are equipped with probes of different geometry and size for the measurement of gears and basically dimensional and geometrical measurands on predominantly rotationally symmetrical workpieces. The probe tip diameters are usually larger than 0.3 mm for micro gear measurements. With the new micro probing system and its high sensitivity styli with significantly smaller probing tips can be used. In this way, the aim is to measure gears with modules below 1 mm.



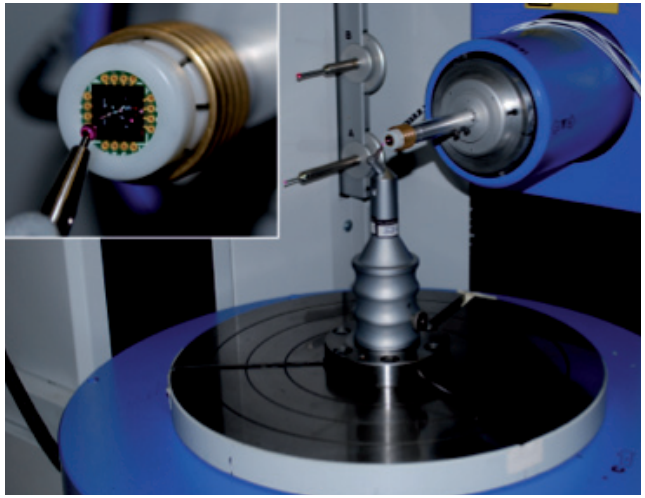
Microprobes for micro gear measurement

The microprobe is based on a sensor element made of silicon, an affixed stylus with a micro probe tip and a shaft length of approximately 5 mm. The principle of the microprobe allows measurements with contact forces of only a few mN to be carried out. This is particularly advantageous for the measurement of micro components.

Integration into measuring instrument

In most of the measuring instruments, a change plate forms a standard interface between probe and probing system. For this reason, also the microprobe is fastened to the change plate by means of a mechanical adapter.

When measurement objects are probed, forces occur which deflect the microprobe. The circuitry integrated in the sensor delivers voltages which are amplified and then digitalized in a measuring amplifier. The internal controller converts the electric signals of the microprobe into spatial deflections. By default, standard probing systems are deflected by 200 µm, whereas the deflection is limited to 50 µm in the case of the new microprobe. For the quantification of the probe and the subsequent gear measurement, only a few adaptations in the measuring software have to be realized by the measuring instrument manufacture.



Calibration of the microprobe on a 2 mm calibration sphere