

Tip- and laser- based micro and nanofabrication in extended areas on flat and non-flat surfaces

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Abstract

More and more new AFM tip-based or laser structuring methods have been attracting attention as alternative lithography approaches for some years now. But most of them have only been demonstrated in the micrometer range so far, and measurement and positioning technology is usually inadequate.

In recent years, nanopositioning and nanomeasuring machines (NPMM) have been developed at TU Ilmenau that are capable of measuring three-dimensional objects in the tens to hundreds of millimeters range with nanometer precision and subnanometer resolution [1]. The decisive basis for this is the consistent application of the Abbe comparator principle and the use of high-resolution fiber-coupled laser interferometers.

To achieve an advance in nanofabrication, latest optical and tip-based nanofabrication technologies are now synergistically combined with the extreme accuracy of the NPMM. In addition to the application of direct laser writing (DLW) via one- and two-photon polymerization, AFM-based, i.e., scanning probe lithography techniques and nanoimprint lithography are being used.

Due to the high static and dynamic positioning accuracy, trajectories can be driven with enormous precision on the surfaces to be patterned and these can be micro- or nanostructured by highly localized interaction between tool and resist. Using 2-photon polymerization, 30 nm ridge widths could be achieved, while 1-photon DLW can also be used to describe non-planar surfaces, such as lenses. Tip-based SPL enables nanostructuring down to the single-digit nanometer range on wafers up to 4 inches. The combination of these different techniques on the NPMM platform also allows the realization of mix and match techniques with high overlay accuracy.

In the talk, the applied techniques will be described in more detail and recent experimental results will be presented.

[1] E. Manske, G. Jäger, T. Hausotte, R. Füßl: Recent developments and challenges of nanopositioning and nanomeasuring technology. Measurement Science and Technology 23 (2012), 074001 (10pp)