

Interferometrically controlled, scalable x-y planar positioning stage concept

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Abstract

There are countless applications for x-y-positioning stages with nanometer positioning accuracy. In the field of semiconductor fabrication and related research areas sub-nanometer resolution is required, but also in precision manufacturing of mechanical components, optics inspection and qualification of sensor systems the requirements shift from tens of nanometers to the single nanometer. In this context, the demand for increasing positioning ranges is especially challenging. Displacement interferometers are commonly used as feedback systems because they offer high resolution and linearity independently from the measurement range. As the positioning range, hence the dimensions of the system increase, thermal stability of all components in the measurement loop is crucial, even under very controlled environment. In the present system ultra-stable differential interferometers are implemented. The mechanical setup consists of a platform on planar air bearings. In-plane lateral motion and rotation is driven by a flat coil system integrated in the granite base. With the granite flat surface being the only guide, typical disadvantages of stacked mechanical guides are avoided ¹. This concept is scalable up to several hundred millimeters. In a first step it was implemented in the NFM100 NanoFabrication Machine². This platform device for Atomic Force Microscopy and various probes for nanomeasuring and nanofabrication research provides a 100 mm diameter motion range and an universal interface for mounting different probes and sensors³. In this paper the mechanical setup and the properties of actuators and sensors are described. Measurements of the positioning performance and results obtained long line-scans with an Atomic Force Microscope are shown. Finally, limitations to scalability and options for integration of a third positioning axes are discussed.

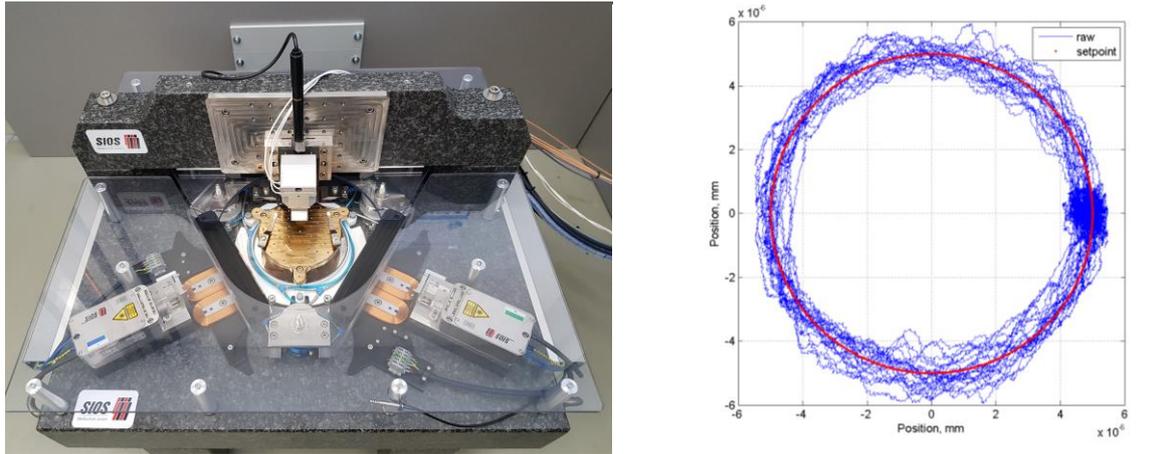


Figure 1: (left): Planar x-y-Stage test setup, (right): Position values for 10 nm diameter circle

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