COORDINATE INTERFEROMETRIC MEASUREMENT FOR HIGH-RESOLUTION LITHOGRAPHY

Lazar J., Holá, M., Čížek, M., Oulehla J., Řeřucha Š., Číp, O., Šarbort, M., Hucl V.

Institute of Scientific Instruments, CAS, Brno, Czech Republic

We present a design of a coordinate interferometric measuring system for precision positioning of a sample-carrying translation stage with two degrees of freedom. The system is intended to operate in an e-beam lithography with reproducibility of the position on nanometre level, following the resolution of the scanned e-beam. The coordinate measuring system operates in differential configuration where the position is measured with respect to a central reference point to eliminate deformations caused by thermal and pressure effects on the body of the vacuum chamber. The reference is here the electron gun of the writer. The interferometer is designed to operate at infrared telecommunication wavelength due to the risk of interference of stray light with sensitive photodetectors in the chamber. The laser source used is a narrow-linewidth semiconductor laser with fiber-based external cavity with high-frequency modulation capability. Detection of the interferometric signal relies on a novel derivative technique motivated by an effort to avoid quite complex optics necessary for homodyne detection (that would have to by designed and adjusted for the infrared wavelength) or the need for two-frequency laser for a heterodyne system. This technique also exploits the key advantage of a laser developed primarily for telecom applications – the possibility of high frequency modulation (over 5MHz to meet the velocity requirement). The quadrature sine/cosine signal, that represents the rotating phase vector, is generated using a phase-sensitive derivative detection.