

Flatness Measurement with the World's Best Measurement Uncertainty

Flatness is an important parameter for various industrial products particularly silicon wafer, hard disk substrate, flat panel display, and other products. The large aperture flatness interferometer was developed by the AIST with the collaboration of FUJINON Company. The flatness of a specimen is compared with a precisely polished reference optical flat whose flatness has been calibrated with respect to the mathematical absolute flatness. The interferometer is capable of measuring flatness over a 300 mm diameter area with an uncertainty as low as 10 nm, which is the smallest uncertainty in the world.



Flatness interferometer (measuring size: 300 mm diameter, uncertainty: 10 nm)

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Development of Small-angle Measurement and Calibration Method

An angle generator equipped with a self-calibration mechanism has been developed. Its angular span is more than 30°. The angular displacement of the axis of rotation is measured by an angle interferometer, which observes the displacement of two retro-reflectors attached to the rotation axis. The angle is calculated from the function of the observed interference order parameterized by the separation of the retro-reflectors and wavelength of the laser. To avoid the effects of long-term drift of the separation and wavelength due to a meteorological change, a self-calibration method is introduced. The self-calibration is realized by a 24-sided optical polygon attached to the axis through an indexing face gear with a 1° resolution. The autocollimator is calibrated by comparing its readings against

angles set by the angle generator. Last year, a single-axis autocollimator calibration service was commenced using this system with an uncertainty of 0.1'' and angular span of +/-1000''.



Photograph of the autocollimator calibration system consisting of the angle generator and angle interferometer.

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