Precision Mechanical Design for a Hard X-ray Nanoprobe Instrument with Active Vibration Control in Nanometer Scale*

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We are developing a new hard x-ray nanoprobe instrument, which is one of the centerpieces of the characterization facilities of the Center for Nanoscale Materials (CNM) being constructed at Argonne National Laboratory (ANL). This new probe will cover an energy range of 3-30 keV with 30 nm special resolution [1]. Imaging and spectroscopy at this resolution level require staging of x-ray optics and specimens with a mechanical repeatability of better than 10 nm.

Fast feedback for d ifferential vibration control between the zone-plate x-ray optics and the sample holder has been implemented in its design using a DSP-based real-time closed-loop feedback technique. A specially designed, custom-built laser Doppler displacement meter system provides two-dimensional differential displacement measurement with subnanometer resolution between the zone-plate x-ray optics and the sample holder. The entire scanning system was designed with high stiffness, high repeatability, low drift, and flexible scanning schemes.

Precision mechanical design of the hard x-ray nanoprobe, as well as test results from an “Early User Instrument”, which we have developed to test a novel two-dimensional interferometrically controlled scanning stage system [2], are presented in this paper.

References:
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