High Precision Positioning Mechanisms for a Hard X-ray Nanoprobe Instrument*

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Abstract

A hard x-ray nanoprobe beamline is being developed at the Advanced Photon Source (APS). The beamline will house a hard x-ray nanoprobe instrument, one of the centerpieces of the characterization facilities of the Center for Nanoscale Materials (CNM) being constructed at Argonne National Laboratory (ANL). The nanoprobe instrument will operate with photon energies between 3 keV and 30 keV with 30-nm special resolution. Imaging and spectroscopy at this resolution level require staging of x-ray optics and specimens with a mechanical repeatability of better than 10 nm [1].

The instrument will combine a scanning probe mode with a full-field transmission mode. It uses x-ray fluorescence for trace-element mapping and spectroscopy; x-ray diffraction to obtain local structural information such as crystallographic phase, strain texture, and x-ray transmission in phase; and absorption to image internal structures of complex devices.

The high-precision positioning mechanisms for the nanoprobe presented here consist of the following major component groups: a granite base with vibration isolators, an optomechanical instrument vacuum chamber, a robotic detector manipulator for microdiffraction, an in situ optical microscope, and a translation-stage system for a transmission imaging detector [2]. Precision positioning mechanisms for a differential scanning stage system with active vibration control in nanometer scale are also presented in this paper.

*This work was supported by the U.S. Department of Energy, Office of Basic Energy Sciences, under Contract No. W-31-109-ENG-38.

References:
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