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Nanopositioning Support Laboratory Strategy Document

Strategy

The mission of the Nanopositioning Support Lab is to provide engineering and technical support to enable world-class performance of nanopositioning instruments for APS operations and research as well as for APS Upgrade project. This mission is accomplished by pursuing the following goals:

- Maintain a world class nanopositioning instrument testing lab to support mechanical metrology needs with nanometer scale for APS Upgrade project and APS x-ray beamline operations and research.
- Provide customized nanopositioning stages design to support XSD scientists' state of the art technologies that expand the impact of x-ray methodologies.
- Provide leading-edge structural dynamics analysis based on experimental results in nanometer scale to support APS x-ray beamline operations and the Upgrade project.
- Pursue novel nanopositioning design, prototyping, and testing for DOE funded R&D projects such as the Hard X-Ray Free-Electron Laser Oscillators project and the Wavefront-preserving Optics project.
- Pursue national and international collaborations in nanopositioning research and development through Argonne Strategic Partnership Projects.

Currently, in collaborations with APS staff from the Optics group and other X-ray Science Division groups, numerous novel customized precision nanopositioning stages have been designed, assembled, and characterized at the APS nanopositioning support lab, including new flexure stages for the hard x-ray nanoprobe instrument at APS 26-ID, alignment apparatus for multiple Fresnel zone plates intermediate-field stacking at APS 2-ID and 32-ID, a multi-dimensional alignment apparatus for the linear multilayer Laue lenses test-bed at APS 1-BM, and K-B mirror flexure manipulating stages for sub-50-nanometer scale hard x-ray focusing at APS 34-ID, as well as for K-B mirrors designed for the APS Upgrade project.

Five-year Goals

- Expand the capability of the laboratory for multi-axis nanopositioning instrument diagnostic and testing.
- Expand the capability of the laboratory for active vibration control in nanometer scale.
- Deploy modular/portable mechanical metrology tools with sub-nanometer resolution and stability.
- Deploy modern design and analysis tools for novel flexural stages design aligned with major scientific thrusts of the APS with upgraded source.
- Identify a new generation of nanopositioning stage projects aligned with the needs of the APS new generation x-ray nanoprobe.

Goals for 2019

- Continue to design prototypes of nanopositioning systems for x-ray nanofocusing for the APS Upgrade project.
- Optimize the design of the flexural mechanisms for x-ray nanofocusing systems and sample stages for x-ray microdiffraction and/or x-ray microscopes at APS sectors 2, 7, 8, 26, 32, and 34.

- Optimize the design for multiple zone plates precision alignment apparatus for hard x-ray focusing in twenty-nanometer scale for APS operations and Upgrade project.
- Continue to design, analyze, and test the nanopositioning system for DOE APS Optics project.
- Continue to survey of ground vibration noise at the APS experiment floor and the new remote experiment station area for the APS Upgrade project.
- Continue to develop advanced ultrahigh-precision mechanisms for synchrotron radiation special monochromators and experimental instruments for ANL-LDRD, XSD and other APS users.
- Continue to improve nanopositioning metrology techniques for APS beamlines operations and APS Upgrade project.
- Continue to pursue international collaborations in nanopositioning research and development through Argonne Strategic Partnership Projects 857Y2 with European-XFEL, 85H21 with PAL-XFEL, 85E77 with SSRF, and 85J05 with BSRF.