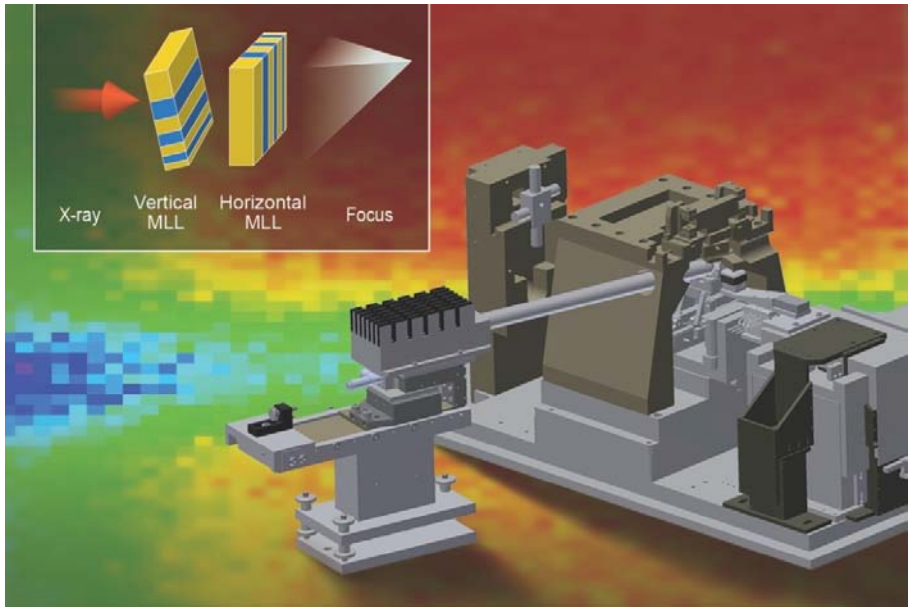
Imaging with Nanoscale Resolution at NSLS-II

Scientific Achievement

Developed systematic approach to address and limit drifts and vibrations during nanoscale imaging in the hard x-ray regime. Work resulted in a working prototype scanning fluorescence microscope with excellent stability and capability to perform sub-10 nm resolution experiments.

Significance and Impact

The method will enable construction of new x-ray microscopes or upgrades of existing microscopes for noninvasive hard x-ray exploration at 10-nm or less spatial resolution.



Computer-aided design (CAD) model of the multilayer Laue lenses (MLL) fluorescence microscope prototype, with inset of the MLL setup used to perform scanning fluorescence experiments. Background image is a fluorescence pattern obtained by raster scanning over a gold test pattern, taken over 6 hours. During data acquisition thermal drifts did not exceed 45 nanometers. The synchrotron measurements confirm high stability of the prototype instrument measured at the Nanopositioning Laboratory of the National Synchrotron Light Source II.

Research Details

- Tests to reduce background noise in spatial resolution and confirm long-term stability of interferometer hardware and electronics of the scanning fluorescence microscope were completed at the Nanopositioning Laboratory of the National Synchrotron Light Source II.
- Characterization of the prototype included stability and resolution testing of the interferometer, thermal imaging and mapping of thermal drifts. Performance was verified during synchrotron experiments at the collaborating institution by imaging gold test patterns.

E Nazaretski, J Kim, H Yan, K Lauer, D Eom, D Shu, J Maser, Z Pešić, U Wagner, C Rau, and Y S Chu, *Review of Scientific Instruments,* **84** 033701 (2013)

Work was performed at Brookhaven National Laboratory, Argonne National Laboratory and Diamond Light Source