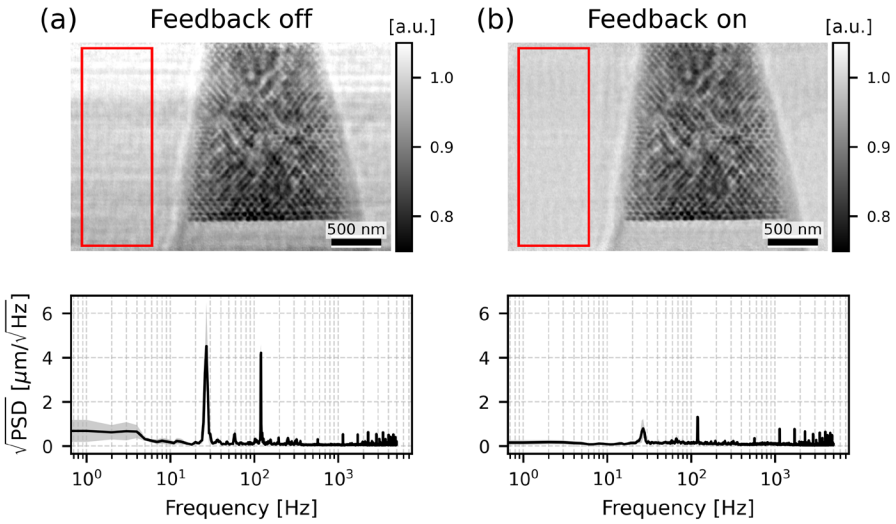
Electron Beam Fast Feedback Improves X-ray Beam Stability



Ptychography reconstruction (top) of a gold nanoparticle superlattice acquired at a dwell time of 3.2 ms, showing the electron-beam-based X-ray feedback off (a) and on (b), using the X-ray beam position monitor at the secondary source aperture focal point as the input. The beam vibration spectra (bottom) show the corresponding horizontal X-ray beam motion measured by the X-ray beam position monitor. The red box indicates the region of interest (ROI) used for analysis. The scan step size was 20 nm × 20 nm with a 200 × 100 grid.

Scientific Achievement

Researchers developed and demonstrated a new fast feedback system that uses the electron beam itself to actively suppress X-ray beam vibrations, improving beam stability at the Hard X-ray Nanoprobe.

Significance and Impact

The approach enables more stable, high-speed X-ray imaging with fewer vibration-induced artifacts, providing a promising path toward meeting the demanding stability requirements of next-generation synchrotrons.

Research Details

- Integrated X-ray beam position monitors with the fast orbit feedback system, enabling the electron beam to suppress vibrations beyond the reach of conventional mechanical feedback and reducing dominant vibration peaks by more than 80%.
- Verified the approach with ptychography measurements, producing cleaner images with fewer vibration artifacts while identifying improvements needed for routine operation.

S. Kongtawong, Y. Hidaka, H. Yan, G. Wang, K. Ha, Y. Tian, J. Mead, D. Padrazo, Y. Chu, and T. Shaftan, Development of electron source feedback for enhanced X-ray beam stability at NSLS-II, *J. Synchrotron Rad.* **33**, 585–595 (2026). https://doi.org/10.1107/S160057752600233X

Brookhaven National Laboratory