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X-Ray mirror carbon contamination removal test at ESRF

The performance of reflective optics such as X-ray mirrors or diffraction gratings generally degrades following exposure to high intensity X-ray or EUV beams. The most common degradation phenomenon is beam-induced contamination with the formation of inhomogeneous carbonaceous films on the optical surface.
Most X-ray light sources suffer from these effects which progressively reduce the optical reflectivity of the optic but can also introduce spurious signals into spectroscopic data. For tender and hard X-ray energies, phase-shifts of the X-rays after transmission though in the irregular thickness contamination film create perturbations in the reflected wavefront which can degrade focus quality. For diffractive crystal optics, contamination can cause strains in the crystal lattice which may give rise to spurious structure in the intensity profile of the diffracted beam. In time, performance degradation can become so severe that the optic becomes unusable with obvious impact to the performance of the analytical instrument.
Various light sources have investigated strategies to mitigate or remediate such contamination using in- or ex- situ techniques but, given the diversity of optical devices, either the methods are not generally applicable or the potential deleterious impact on the performance of the highest performance optics may not be well studied.
In order to build in-house expertise for the refurbishment of contaminated mirrors we have performed tests on several cleaning and remediation methods: UV-Ozone exposure, oxygen plasma treatment and stripping of various different coating materials. The impact of such treatments on micro-roughness and X-ray reflectivity measurements is presented.

Journal of Synchrotron Radiation Special Issue: will you submit your contribution?

yes

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