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Synchrotron- and substrate-induced structural modifications in adventitious carbon layer on beamline optical elements

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The XRD2 and XPRESS beamlines of Elettra, the Italian synchrotron facility, share a multipole semiconducting wiggler as photon source. XRD2 receives light from the central portion of the photon beam while a Si(111) beam splitter, at an incident angle of 4.5°, reflects a side portion of the radiation cone towards XPRESS. Upon dismounting, the crystal showed an unexpected, longitudinal, 4 mm-wide stripe on the optical element surface, clearly correlated with the beam footprint.

We will show the structural and chemical characterization performed in trying to understand what occurred to the crystal surface. Fizeau Interferometry revealed that the stripe was a relatively bulky bump, roughly 500 nm high at the initial incident point of the beam, and gradually decreasing along the crystal. Interestingly, X-ray Diffraction did not show any local variation of the Si crystal lattice parameter, ruling out any possible thermally-induced deformation. Finally, Infrared and Raman Spectroscopy allowed us ascertaining the adventitious carbon composition of the bump, also suggesting a non-amorphous layer and its hybridization states.

This study highlights the role played by carbon, as a common and diffuse contaminant, on affecting the performances of X-ray optical elements. Moreover, it confirms the occurrence of significant structural changes in the carbon layer, as the result of complex interactions with the substrate, *i.e.* the optical element surface, and the synchrotron radiation.

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

yes

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