FOCUS ON

When visible light
serves invisible light

The metrology laboratory in the optics group uses visible light to scrutinize the optics installed on the beamlines. In most cases, the focusing optics are mirrors used at grazing incidence; this is why they are very elongated in the propagation direction of the X-ray beam. The laboratory uses visible light to provide what can be seen as a «Google Maps» necessary to validate the optics before assembly, as the surface of these mirrors must be mapped on all scales ranging from a dozen centimeters to a nanometer. This process requires several measurement tools and is based on different methods of analysis.

The metrology laboratory is installed in a cleanroom, or in other words, a room where the dust and humidity levels, as well as the temperature, are controlled. What makes such close control necessary is that dust absorbs X-radiation, and changes in temperature and humidity disrupt the quality of the probing beams. The history of the laboratory starts with the LURE laboratory in 1996 with the development of the Long Trace Profiler (LTP) optical profilometer capable of characterizing the radii of curvature and large-scale defects (> 1 mm) which directly interfere with the geometry of the focused beam. Its resolution is about 2 nm. The LTP was transferred to SOLEIL at the end of 2005, along with other instruments completing the range of observable scales available in the laboratory. Since then, three phase scanning interferometers with complementary magnifications, a Shack-Hartmann type wave front sensor and atomic force microscope head have been installed in the laboratory. Some of these instruments have been entirely developed by the optics group while others are commercial instruments that have been significantly modified.
The lab team had to address a first challenge with the characterization of all 250 optics installed on the beamlines with uncertainty below 5 nm in height.

Now a new challenge has arisen with the development of sources producing diffraction-limited radiation, as the researchers have to make sure that SOLEIL's future optics do not alter the quality of the radiation. Uncertainty due to measurement errors should remain below 1 nm. That being said, recent developments in instrumentation and analytical methods have enabled the optics group to achieve uncertainty below 2 nm. The team is putting forth effort to reach that one last nanometer-a new goal that shall maintain the lab at the highest level internationally.

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