Development of aspherical X-ray mirrors for nanofocusing

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We present a fast and robust ion beam etching technique to profile initially flat surfaces into aspherical ones suitable for X-ray nanofocusing.

The profiling method uses a double-blade system placed between a broad ion beam source and a mirror to modulate spatially the ion dose along the mirror surface. Two surfacing methods are developed. The first one consists of moving two blades in opposite directions with two independent variable-speed profiles to approach the desired shape in a time-effective way. In the second method, a slit of fixed width is moved at variable speed over the sample thus modulating the ion dose along the mirror for correcting residual errors left out by the previous shaping process. An iterative process is eventually applied to progressively and selectively remove material along the mirror until the target aspherical surface profile is reached. At each surfacing step a correction is applied to the removal function based on surface slope error *Long Trace Profilometry* measurements performed on the surface obtained at the previous step.

The method was successfully applied to produce a set of elliptically shaped mirror prototypes with large demagnification values (M=900-3000) suitable for nanofocusing. The residual root mean square (rms) slope errors were less than 1 arcsec over a mirror length of 40 mm and the rms shape errors lower than 5 nm. The rms roughness remains below 0.2 nm for spatial periods up to than 130 □m.