Bimorph mirrors: Performance and optimization on the microfocus spectroscopy beamline at Diamond

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The microfocus spectroscopy beamline at Diamond has been operational since January 2007 and uses bimorph KB mirrors to routinely deliver a 3 micron beam to users. To initially optimize the mirrors in-situ the "pencil-beam" method of Hignette is employed [1]. This involves scanning a narrow pair of slits before the mirror to selectively illuminate sections of the mirror and observing the position of the reflected beam on an x-ray beam position monitor. The voltage of each element on the bimorph is incremented and the scans repeated to build a correction matrix. This technique has been used on the beamline to focus the incoming beam to 5-8 microns but to achieve further improvements to the focused beam size an iterative non-linear optimization scheme was developed. This approach uses knife-edge scans to obtain the beam profile and adjusts the voltages on the bimorph mirror until a satisfactory beam shape is achieved. Using this technique the beam size can be further reduced to 3 microns.

From the design specifications and initial slope errors of the vertically focusing KB mirror (0.9 μrad slope error uncorrected, 0.5 μrad corrected) a 1 micron beam spot should be obtained but this was never achieved in practice. To understand the problems achieving this focus the mirror was recently removed from the beamline and studied at the Diamond metrology lab. The mirror is 200 mm long with a 175mm active area and is designed with a central 150mm long piezoelectric stack with additional 25mm long piezoelectric sections attached at each end. The mechanical junctions between the central and outer piezoelectric sections were found to exhibit

very large slope errors (~15μrad) and the uncorrected slope error in the central region is now 2.6 μrad, reducing to 1.5μrad with voltage correction. The potential causes for this degradation in performance will be discussed.

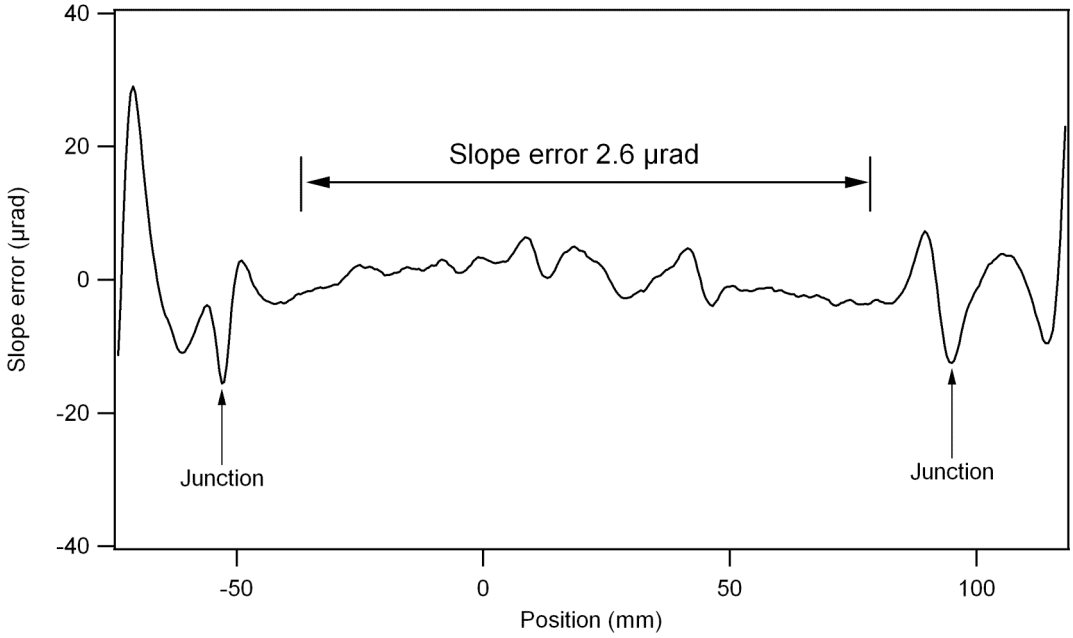

Figure 1. Slope errors measured from the vertical KB mirror at zero volts

References

[1] O. Hignette, A.K. Freund and E. Chinchio, *Proceedings of SPIE* **3152**, (1997) 188

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