

Recent progress in adjustable X-ray optics for astronomy

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Two adjustable X-ray optics approaches are being developed for thin grazing incidence optics for astronomy. The first approach employs thin film piezoelectric material sputter deposited as a continuous layer on the back of thin, lightweight Wolter-I mirror segments. The piezoelectric material is used to correct mirror figure errors from fabrication, mounting/alignment, and any ground to orbit changes. The goal of this technology is to produce Wolter mirror segment pairs corrected to 0.5 arc sec image resolution. With the combination of high angular resolution and lightweight, this mirror technology is suitable for the Square Meter Arc Second Resolution Telescope for X-rays (SMART-X) mission concept. The second approach makes use of electrostrictive adjusters and full shell nickel/cobalt electroplated replication mirrors. An array of radial adjusters is used to deform the full shells to correct the lowest order axial and azimuthal errors, improving imaging performance from the 10 – 15 arc sec level to ~ 5 arc sec. We report on recent developments in both technologies. In particular, we discuss the use of in-situ strain gauges on the thin piezo film mirrors for use as feedback on piezoelectric adjuster functionality, including their use for on-orbit figure correction. We also report on the first tests of full shell nickel/cobalt mirror correction with radial adjusters.