

A soft X-ray beam-splitting multilayer optic for the NASA GEMS Bragg Reflection Polarimeter

Ryan Allured · Mónica Fernández-Perea · Regina Soufli · Jennifer B. Alameda · Michael J. Pivovarov · Eric M. Gullikson · Philip Kaaret

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Abstract A soft X-ray, beam-splitting, multilayer optic has been developed for the Bragg Reflection Polarimeter (BRP) on the NASA Gravity and Extreme Magnetism Small Explorer Mission (GEMS). The optic is designed to reflect 0.5 keV X-rays through a 90° angle to the BRP detector, and transmit 2–10 keV X-rays to the primary polarimeter. The transmission requirement prevents the use of a thick substrate, so a 2 μm thick polyimide membrane was used. Atomic force microscopy has shown the membrane to possess high spatial frequency roughness less than 0.2 nm rms, permitting adequate X-ray reflectance. A multilayer thin film was especially developed and deposited via magnetron sputtering with reflectance and transmission properties that satisfy the BRP requirements and with near-zero stress. Reflectance and transmission measurements of BRP prototype elements closely match theoretical predictions, both before and after rigorous environmental testing.

Keywords Multilayers · X-ray polarimetry · Beamsplitters · Thin films

R. Allured (✉) · P. Kaaret
University of Iowa, Iowa City, IA, USA
e-mail: rallured@gmail.com

M. Fernández-Perea · R. Soufli · J. B. Alameda · M. J. Pivovarov
Lawrence Livermore National Laboratory, Livermore, CA, USA

E. M. Gullikson
Lawrence Berkeley National Laboratory, Berkeley, CA, USA