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

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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