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High-stability double multilayer monochromator with gravity-driven water cooling for the SDB beamline at HEPS

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Multilayer monochromators are commonly employed in photon hungry synchrotron beamlines to deliver intense, monochromatic X-ray beams. We present the design, validation, and beamline integration of a high-stability, high energy (20-70keV) double multilayer monochromator developed for the Structural Dynamics Beamline (SDB) at HEPS. The system features a novel flexure-based architecture, optimized via finite element analysis (FEA), to significantly enhance stiffness, particularly in the roll direction of the Bragg axis. A monolithic flexure mechanism is employed for pitch and gap adjustment of the second multilayer, improving mechanical integrity and stability. A special gravity-driven water cooling system, coupled with a unique indium-gallium interface for clamping and thermal contact, was developed to suppress vibrational disturbances. FEA simulations and experimental validation confirmed a clamping-induced deformation below 69 nrad RMS. A vibration level as low as 5 nrad under cooling was measured by laser interferometry. The system has been successfully installed and tested with synchrotron beam, meeting requirements of the beamline.

Footnotes

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