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Grating mirrors active cooling system design for soft X-ray monochromator

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We present an active cooling system for the grating mirrors of ID32 soft X-ray beamline at the European Synchrotron Radiation Facility (ESRF). The design combines flexible copper braids to minimize mechanical stress in the grating mirrors with active temperature control to accelerate thermal response. Development followed a model-based approach, integrating dynamic Simulink thermal simulations with static finite element analysis. Under variable beam heat loads, the system maintains mirror temperature stability within ± 2 mK and reduces thermal settling time from several hours to under 10 minutes. Interferometric measurements confirm improved optical surface flatness, with the cooling system contributing less than 50 nrad RMS to slope error. This enhancement translates to improved beamline energy resolution from 25.6 meV to 22 meV.

Footnotes

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