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Optimized design of a mechanical clamping device for surface shape testing

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Clamping-induced deformation of the double-crystal monochromator (DCM) is a critical issue that urgently requires resolution. Due to challenges posed by high-radiation and ultra-high-vacuum environments, current DCM clamping devices rely heavily on computer simulations and lack support from measured data. To address this problem, we have developed a real-time clamping force acquisition device to measure surface shape changes of optical components under different clamping forces. In the offline state, interferometry is used to quantify relationships between clamping force and surface peak-to-valley (PV) as well as root mean square (RMS) values. In the online state, 2D detectors and orthogonal analyzer crystals enable direct observation of Dumond diagrams of the crystal under test, achieving qualitative characterization of surface shapes. This study resolved the issue of uneven clamping force through structural improvements and established quantitative correlations between clamping force and surface shape changes.

Footnotes

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