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Clamping deformation patterns and solutions for LN2 cooled monochromator crystal

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This study reveals the limitations of indium as a thermal interface material for LN2-cooled monochromator crystal. Under clamping force, the indium foil forms excessively strong contact with the cooling block and the crystal, exhibiting a bonding-like characteristic. This transmits the shear force generated by the thermal expansion coefficient difference between the cooling block and the crystal within the contact plane, leading to significant clamping deformation, which far exceeds the deformation caused by the clamping force itself. Moreover, since the actual contact state between the crystal and the cooling block is difficult to assess, asymmetric surface distortion is easily induced. Based on the above low-temperature clamping deformation patterns, this paper proposes replacing indium foil with graphite materials as thermal interface materials. Experimental test results demonstrate that the inherent lubricating properties of graphite materials significantly reduce the shear force acting on the crystal. Additionally, specially structured graphene exhibits high thermal conductivity, ensuring good thermal contact while minimizing clamping deformation.

Footnotes

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