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Corrosion-suppressed thermal interfaces with indium-gallium alloy for high-energy synchrotron beamline cooling

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TIM (Thermal interface materials) is critical component for mitigating the thermal load from high-energy X-rays in beamline systems. This paper presents the effectiveness of anti-corrosion coatings in liquid metal gap cooling systems and their painting processes, demonstrating significant reductions in interface corrosion and gas entrapment at contact surfaces We developed an in-situ thermal resistance experimental setup, verifying that the contact thermal conductance exceeds 60,000 W/(m²·K), which has less affect on cooling and thermal deformation. Tests on outgassing rates of anti-corrosion layer and InGa demonstrate compliance with stringent requirements for vacuum compatibility and fluidity. The development of these technologies will provide a significant enhancement in the reliability of liquid metal-based cooling solutions for high-heat-load optical components.

Footnotes

Funding Agency

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