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C1Po1D-04: Design and performance evaluation of a closed-cycle ^{3}He sorption cooler

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Cryogenic technology plays a significant role in ground experiments and space exploration. ^{3}He sorption refrigeration is one of the few methods capable of achieving temperatures below 500 mK, and due to its advantages such as small size, light weight, no vibration, no electromagnetic interference, and simple operation, it has considerable competitiveness in the field of space ultra-low temperature refrigeration. We demonstrate the design and performance evaluation of a closed-cycle single-shot ^{3}He sorption cooler, which integrates a cryopump filled with activated carbon granules, and analyze the heat and mass transfer characteristics of different adsorption bed structures. The ^{3}He sorption cooler, pre-cooled by a two-stage GM pulse tube refrigerator and a superfluid helium bath, achieves a minimum temperature of 394 mK and provides a net cooling power of 200 μW at 486 mK. The performance of the ^{3}He sorption cooler needs further optimization and will be used for pre-cooling of adiabatic demagnetization refrigerators in the future.

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