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An optimized entropy filter used in a 2K system cooled by a G-M cryocooler

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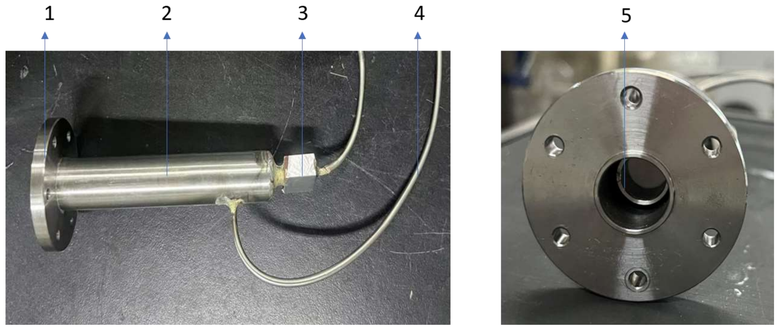
Abstract

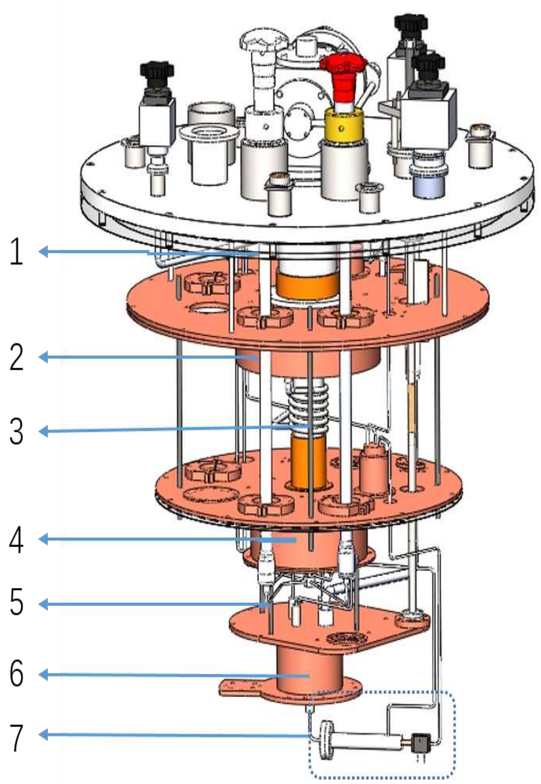
✓An entropy filter assembly, used in a 2K cryostat cooled by an G-M cryocooler, has been designed, established and optimized in this work.
✓The pore size distribution of the entropy filter was characterized to observe the minimum, maximum pore sizes and average pore sizes.
✓The He-3 diffusion through the entropy filter was calculated under different temperatures, along with the He-3 diffusion coefficient.

The entropy filter assembly



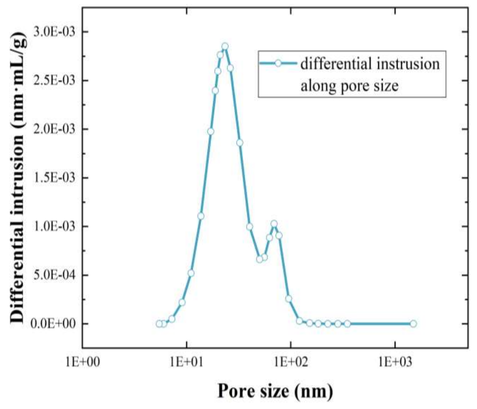
The entropy filter assembly
1-flange; 2-outer tube; 3-Heater; 4-communication capillary; 5-the entropy filter

2K cryostat

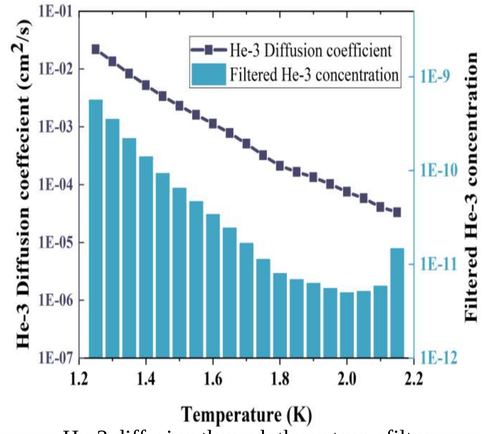


The schematic diagram of the entire cryostat
1-cold trap;2-the first heat exchanger;3-heat enchanger;4-the second heat exchanger;5-J-T valve;6-He-II chamber;7-the entropy filter assembly;

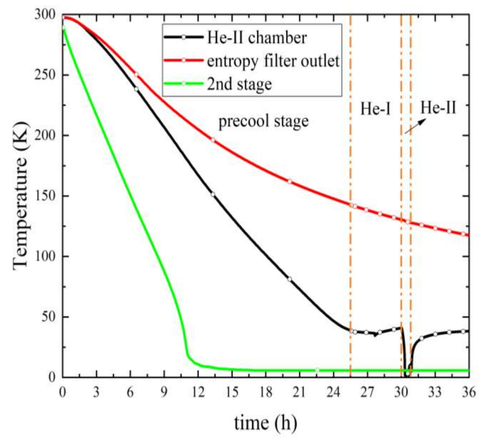
Results and discussions

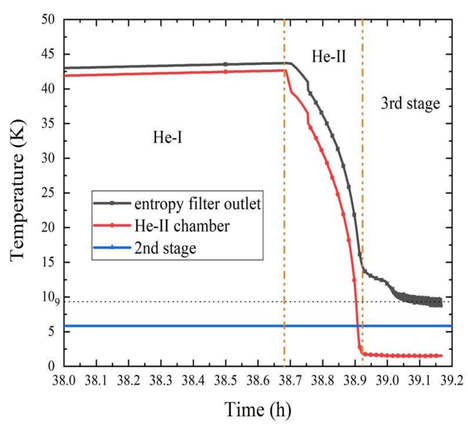


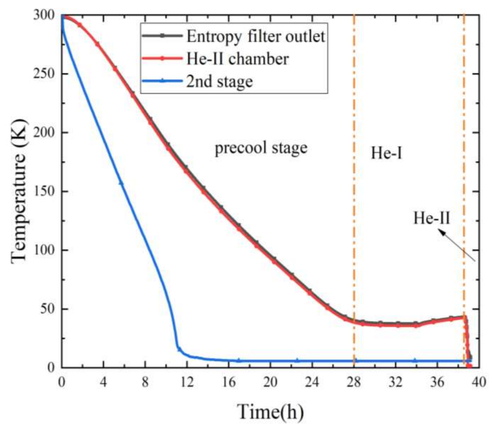
The pore size of the entropy filter

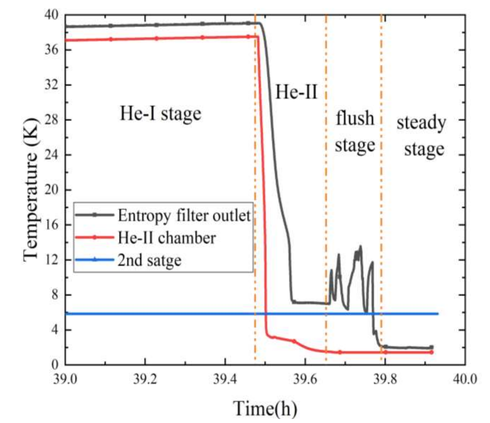


He-3 diffusion through the entropy filter









The cooling curve of the cryostat

Conclusions

✓The average pore size of the entropy filter was around 35nm, with most of pore size smaller than 100nm;
✓The original version entropy filter could be cooled down to 140K when the other parts of the 2K system were pre-cooled completely;
✓The second edition, featuring flexible heat sinks, was able to cool the entropy filter to around 40K after 28 hours;
✓The optimized entropy filter, successfully allowed He-II to flow through the entropy filter, as evidenced by the outlet temperature reaching approximately 1.9K.