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A helium isotope separation system with an optimized entropy filter

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A helium isotope separation system has been established which consisted of a 2K cryostat and a cryogenic separation device with an entropy filter. The 2K cryostat could reach 1.5K, providing a low-temperature environment for the separation device especially the entropy filter. The entropy filter, the core component of the cryogenic separation device, was made of Al2O3 powder which could selectively allow the passage of superfluid. In this paper, the structure of different cryogenic separation devices and the ideal separation conditions have been studied. The resulting entropy filter demonstrated a helium leak rate as low as Pa·m3/s, which was suitable for helium isotope separation. The system could continuously operate to separate helium isotope. The 3He concentration of the entropy filter inlet and the outlet were measured using Helix SFT™ Mass Spectrometry. The concentration of 3He in the feed helium is 3.3E-8 while the 3He concentration of the helium filtered by the system is 2.41E -10. The results indicate that the concentration of 3He separated decreases by two orders of magnitude and this system could separate these two helium isotope with a good performance.

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