

A helium isotope separation device with flow visualization unit

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Distillation, adsorption, and thermal diffusion are commonly employed methods for separating helium-3 and helium-4 isotopes. However, due to the exceptionally low concentration of helium-3 present in natural gas or natural helium, an initial enrichment of helium-3 is necessary to reach the minimum concentration required for traditional separation methods. Entropy filter, a porous element, offers a straightforward and effective method for the preliminary separation of helium-3 and helium-4. This paper introduces a new quantum separation device that employs a GM cryocooler as the cold source and incorporates optical windows for precise real-time flow detection. The main focus of this paper is on the rational design of the 2K cryostat structure and the improvement of the heating method to ensure precise heating of the fluid at the entropy filter outlet. Additionally, a thorough analysis of heat leakage was conducted to ensure that the integration of optical windows would not affect the cryogenic separation process.

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