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C2Or2A-01: An Efficient, Low-Vibration Reliquefier for NMR Spectroscopy Applications

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Cryomech has developed a small capacity, low vibration helium reliquefier for use with commercial NMR cryostats. NMR systems are highly sensitive to vibration and thus utilize liquid helium to cool the magnet. Due to the helium shortage and rising cost of helium, many small labs cannot operate their NMR systems. Large facilities with multiple NMR systems can utilize a large-scale liquid helium plant and helium recovery system eliminate helium loss. However, this is not cost effective for smaller university labs with only one or two cryostats. The reliquefier discussed here is based on Cryomech's existing reliquefier design and uses a PT405-RM pulse tube cryocooler. The system can liquefy 1.44 L/day from room temperature helium and 4.2 L/day from liquid helium boil-off with 5 kW of input power. To operate with the highly sensitive NMR systems, the design had to be modified to isolate the vibration from the pulse tube cryocooler from the cryostat. Through implementing various isolation methods, the dominant frequencies from the pulse tube were reduced by an order of magnitude. In this paper, we discuss the design of the reliquefier, the results of the thermal and vibration tests, and compare scan images from a commercial NMR cryostat with the helium reliquefier installed.

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