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C2Or2A-05: Investigation of improving cool-down speed of Stirling type pulse tube cryocooler with ambient displacer

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For a good cryocooler, besides high efficiency at working temperature, the cool-down speed is also important for some applications. Because of the difference in structure and operation mechanism, different cryocoolers have different characteristics of cool-down speed. This work introduces a Stirling type pulse tube cryocooler with ambient displacer which works at liquid nitrogen temperature region, and a strategy for improving the cool-down speed from room temperature to liquid nitrogen temperature has been investigated through simulation. The pulse tube cryocooler can provide 17.8 W cooling power at 77 K with 180 W input acoustic power at 70 Hz. By fixing the maximum displacer movement in the simulation, we investigate how tuning frequency around 70 Hz can change the cool-down speed. The strategy turns out to be effective in the beginning stage of the cool-down process, an improvement of speed by about 15-20%. The gain becomes less obvious as the cold head temperature drops. In conclusion, tuning frequency during cool-down process helps the cold-head to reach final temperature faster but the average gain is not as big as expected.

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