

CFD Simulation of a Hybrid Cryocooler with Pulse Tube Precooling

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Stirling/Pulse tube hybrid cryocooler (SPC) combines the high efficiency feature of Stirling cryocooler and the high reliability feature of pulse tube cryocooler, which is attractive for space applications with tight requirements on the cryocooler. In this paper, the modelling of a U-type hybrid Cryocooler with a one-stage stirling and two-stage pulse tube is presented. The influence of pulse tube precooling on the temperature field and velocity field in the pulse tube is studied with FLUENT. It is found that precooling can change the internal temperature distribution of the pulse tube and has a great influence on the cooling capacity of the second stage. Without precooling of the pulse tube, the cryocooler outputs its cooling capacity with its second stage of 0.7W@30K and its first stage of 7W@80K, which the input PV power is 133W. When the first stage cold finger is connected to the middle part of pulse tube via a heat bridge, the input PV power is maintained and the cooling capacity changed to 1.2W@30K and 6W@80K respectively. It is found that the precooling of the pulse tube can improve the two-stage capacity of the U-type hybrid cryocoolers.