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Performance Improvement of Pulse Tube Refrigeration with Helium-hydrogen Mixtures

Guobang Chen, Zhihua Gan and Jiang Yanlong
Cryogenics Laboratory, Yugu Road 20#, Zhejiang University, Hangzhou 310027, China P.R.; E-Mail: gbchen@zjuem.zju.edu.cn

Abstract

It is widely recognized that pulse tube refrigerators may be used as a long-term operation machine due to its absence of moving parts in the low temperature region. However, the coefficient of performance of the pulse tube is expected to increase so as to make a competition with conventional machines. To enhance the refrigeration performance of the pulse tube refrigeration, a mixture of helium and hydrogen is proposed as the working fluid instead of pure helium, because hydrogen has a higher performance of heat transfer and lower pressure drops on the working conditions though the adiabatic index of hydrogen is smaller than that of helium.
A number of tests by means of the self-made two-stage pulse tube refrigerator have been carried out and repeated. The experimental results show that both the cooling capacity and COP could be improved more than 20% at 30K temperature region with mixtures of 20-40% hydrogen and the rest helium.