



Contribution ID: 392

Type: **Poster presentation (105min)**

A cryogen-free cryostat for scientific experiment in a pulsed high-magnetic field

Thursday 10 July 2014 10:30 (2h 15m)

Traditional cryostat for scientific experiment in the pulsed high magnetic field uses liquid helium as the cooling source. To reduce the running cost and to increase the operational efficiency, a cryogen-free cryostat based on a GM cryocooler has been developed for a 60 T pulsed field measurement cell at Wuhan National High Magnetic Field Center. The lowest temperature of the cryostat is 1.4 K. A double layer temperature-control insert was designed to obtain a stable temperature in the sample chamber of the cryostat. In order to eliminate the sample temperature fluctuation caused by the eddy current heating during the pulse, the inner layer of the insert is made from fiberglass tubing with epoxy coating. Different from the traditional cryostat, the sample and the temperature controller are not immersed in the 4He bath. Instead, they are separated by helium gas with negative pressure, which makes the heat transfer smoother. At the sample position, a resistance heater wound with antiparallel wires is mounted on the inner layer of the insert to heat the sample. Using the temperature-control insert, the temperature can be controlled with the accuracy of $\pm 0.01\text{K}$ in the range of 1.4 K-5 K, and $\pm 0.05\text{K}$ from 5 K to 300 K.

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Session Classification: Thu-Mo-Posters Session 3.4

Track Classification: C-14: New devices and novel concepts