Calibration of a Cernox Thermometer in Pulsed Magnetic Fields

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Introduction

A Lakeshore Cernox™ 1030BC thermometer to be used as the platform thermometer on a heat capacity stage was calibrated at temperatures from 4K down to 1.4K in magnetic fields up to 33T using the mid-pulse magnet at the NHMFL Los Alamos. The resulting heat capacity system will be used in the 33 T resistive and at the NHMFL Tallahassee to measure heat capacity of ultra clean YBCO.

Experimental

The Cernox™ thermometer was mounted with the excitation current perpendicular to the magnetic field and cooled to 4K. Using the NHMFL Los Alamos digital lock-in amplifier the thermometer was excited with a current of 2.6 μA at a frequency of 10 kHz. Data was taken at a rate of 1 MHz as the magnet was pulsed to 33 T. The short time of the magnetic field pulse (around 50 ms) ensures that the thermometer under test remains isothermal while the data is taken. Data is taken for two magnetic field pulses at each temperature the first the 10T and the second to 33T. Overlaying the resulting data ensures that there is no magnetically induced heating effect during the pulse. The linearity of the high field magneto-resistance allows the 33T trace to easily be extended up to 45T, permitting a faster cool down and less stress of the mid-pulse magnet.

![Image of low temperature field sweeps of a Cernox thermometer](image.png)

Figure 1: Low temperature field sweeps of a Cernox thermometer. The data are plotted in a Labview Runtime 8.5 program that creates a matrix converted the data from R(B) at fixed T into R(T) at fixed B.

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