Direct measurements of the magnetic entropy change

An experimental device that can accurately measure the magnetic entropy change, \( \Delta s \), as a function of temperature, \( T \), and magnetic field, \( H \), is presented. The magnetic field source is in this case a set of counter-rotating concentric Halbach-type magnets, which produce a highly homogeneous applied field with constant orientation. The field may be varied from 0 to 1.5 T in a continuous way. The temperature stability of the system is controlled to within \( \pm 10 \) mK and the standard range for the current setup is from 230 K to 330 K. The device is under high vacuum and we show that thermal losses to the ambient are negligible in terms of the calorimetric determination of the magnetic entropy change, while the losses cannot be ignored when correcting for the actual sample temperature. We apply the device to two different types of samples; one is commercial grade Gd, i.e., a pure second-order phase transition material, while the other is \( \text{Gd}_5\text{Si}_2\text{Ge}_2 \), a first order magnetic phase transition material. We demonstrate the device’s ability to fully capture the thermal hysteresis of the latter sample by following appropriate thermal resetting scheme and magnetic resetting scheme. © 2015 AIP Publishing LLC.