Modular Multichannel Measurement Apparatus for 100T Pulsed Magnet and Critical Current Measurement

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Measurement Tools for High Magnetic Fields

High magnetic fields are very useful for scientific experimentation. When samples are tested in a high field, many insights can be gained into complex properties that may not be so easily observed otherwise. A prime focus of high field facilities is the pursuit of high (quasi-room) temperature superconductors (HTS). When HTS crystals are grown, they are on the order of few microns in size. Special techniques are required to cut them into a specific shape, and provide electrical connectivity. Such small volumes being tested at a time require a great amount of precision in the instrumentation for effective measurement. That is why exceptional efforts were taken in the design and creation of the 100T specific measurement probe.

From Design to Construction

Work on the probe began with computer aided design of parts, ensuring that they were machined to exact pre-defined constraints. The top piece shown (left) is the piece that will protrude out of magnet, such that cables may be connected to instrumentation for data recording. In this multichannel probe, there are eighteen electrical leads available for the user to employ as they wish. One might conduct measurements of transport, structural fluctuations, electrical transport, dielectric properties, polarization, torque magnetometry and so on; with the electric leads. There are also leads for magnetic field, temperature sensing, and a heater coil. Simultaneous optical magnetostriction sample measurements are also possible.

Critical Current Measurement In Superconductor SmFeAsO1-X:F

The probe is first inserted into a cryogenic sample fridge, which is placed into bore of the magnet. Here, the temperature may be as low as 300 milliK. The field acts on the sample, then dependent variables are logged. Shown is the 65T pulse magnet. A room-sized capacitor bank is discharged in a matter of milliseconds to ramp the field to 65T. The probe was first tested in this magnet.

Using the Probe

The probe is designed specifically to fit in the bore of the 100T pulse magnet (shown left). 100T is about 2,000,000 times the strength of earth's magnetic field.

Conclusion

The probe has provided very good data, with high accuracy, sensitivity, and with little noise.

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