ABSTRACT:
This project's goal is to compile a database of material properties that will be utilized in manufacturing a pressure cell to further study the Fermi surface of uranium. We placed BeCu, MP35N, and WC:Ni6 in high magnetic fields and near-absolute-zero temperatures in order to report their specific heat capacity, thermal conductivity, and electrical resistance. Data obtained for BeCu, MP35N, and WC:Ni6 are discussed.

INTRODUCTION:
A common way to study a material's Fermi surface is in a magnetic field, which is why the National High Magnetic Field Laboratory is a perfect venue. In order for measurements to be made, a near perfect pressure cell must first be constructed. These metallic pressure cells are some of the first to experience a high magnetic field pulse, and thus need to be capable of reducing as much of the induced eddy current as possible. The materials used in our pressure cells are BeCu, MP35N, WC:Ni6, Teflon, Kapton, G10, and similar substances. We will use Quantum Design's Physical Property Measurement System (PPMS) to determine these materials' properties, and will report our findings so a pressure cell can be accurately designed.

EXPLANATION:
A pressure cell can be used to study materials that have interesting characteristics under high pressures. The following picture shows the body of a typical pressure cell, and the material that forms it.

METHODS:

Measuring Thermal Conductivity:
* Where P is power (how much energy is pumped into the sample per second), T is temperature, and K is the sample's conductance.
* Conductivity can be extracted from conductance by taking into account the sample's geometry. PPMS measures both the power used to heat the sample and the temperature difference, which is how conductance is found.

Measuring Heat Capacity:
* T is temperature, tau is defined as the sample's heat capacity divided by the conductance of the wires keeping the platform raised, and P is power (either a constant or zero).
* This graph is a convergent exponential, so PPMS fits a curve for tau, and solves for the heat capacity of the sample.

Measuring Electrical Resistance:
* R is resistance of the sample, V is the voltage across the sample, and I is the current through the sample.
* Resistivity is extracted from resistance by taking into account the sample's geometry.

Measuring Addenda Heat Capacity:
* PPMS puts current into the sample and measures the potential difference between two points on the sample and measures resistance.

DATA AND ANALYSIS:

* The graph on the left displays the heat capacity of tungsten carbide as a function of temperature at various magnetic fields.
* Even though WC:Ni6 is magnetic, it is independent of (magnetic) field.

CONCLUSIONS:
* We discovered the following about:
  - Thermal Conductivity (*FI*):
    - BeCu
    - MP35N
  - Electrical Resistivity (*FD*):
    - BeCu
    - WC:Ni6
  - Heat Capacity (*FD*):
    - BeCu
    - WC:Ni6

Note: *FI = Field Independent (within uncertainty) 
*FD = Field Dependent
* Determination of the thermal conductivity of WC:Ni6 is in progress
* There are many more materials to test to complete a pressure cell.
* It is hard to claim anything with the data received, but it is categorized by general trend.

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