Electro-magnet for DAC

Institute for Shock Physics

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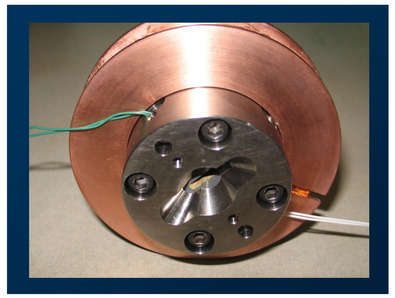
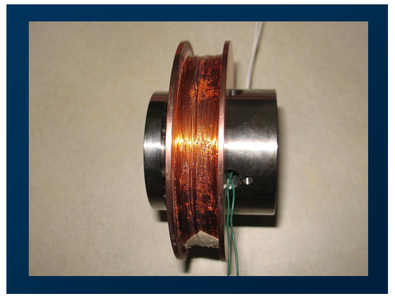
Objective

- To design, build, and calibrate, an electro magnet that can fit over a Diamond anvil Cell, inside a cryostat
- Maximize the parameters to generate as high magnetic field as possible

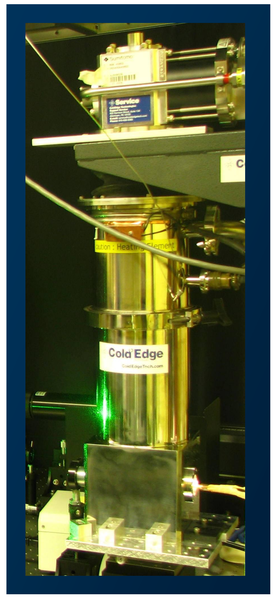
Experiment

- Copper solenoid coil contains 50 layers, with 50 turns per layer, of 30 gauge copper wire
- Sensor was a thin rectangular sample of pure lead that was connected with a four point resistivity configuration
- The coil and DAC where then placed in a cryostat
- Sample cooled from 295k -4k
- Resistivity was calculated from the lead measurements
- A small current was applied to the coil to produce a magnetic field at 70k



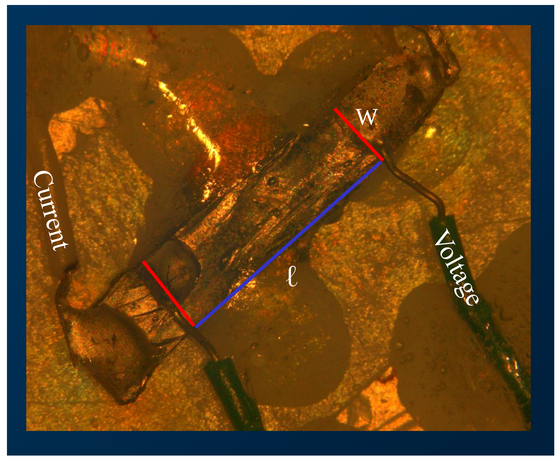


Copper Solenoid Coil on DAC



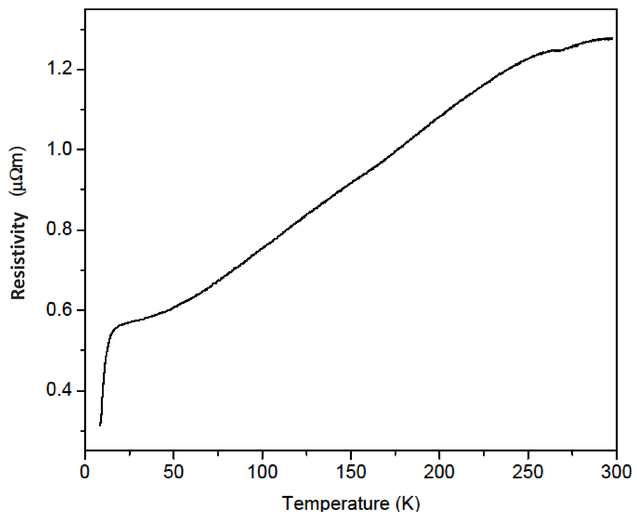
Cryostat

Experimental Results

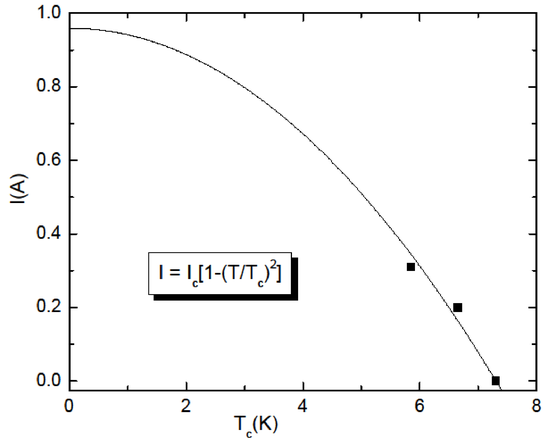


Lead Sensor
w=2217.19μm
ℓ=7379.99 μm
t=702.11 μm

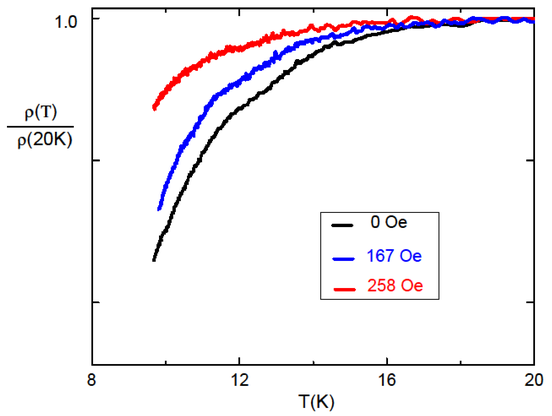
$\rho = RA/\ell$
$A = 1557450.398 \times 10^{-12}\ m^2$
$\rho = R(211.095 \times 10^{-6}\ m)$



Resistivity of lead with zero magnetic field. The sharp resistance drop around 15k is the signature for the on-set of superconductivity



The applied current versus rescaled superconductor transition temperature. The data was fitted with **$I=I_c[1-(T/T_c)^2]$** and Ic found to be 0.96 A.
H is directly proportional to I with above equation and known Hc (800 Oe), H was calculated from the known value of I.



The normalized ρ with different magnetic fields.

Conclusions

1. Magnetic field was successfully generated using copper solenoid coil
2. Magnetic field value of the coil was calibrated against the applied current