
Übungen zu „Elektronische Eigenschaften von Festkörpern II: Supraleitung“ (SS2023)

Exercise sheet 1 · Tutorial on 03.05.2023 · (A.Ustinov/G.Fischer)

1) Surface currents

A flat lead (Pb) specimen is placed in a magnetic field which is parallel to its surface. The critical temperature of lead is $T_c = 7.2$ K and its critical field at zero temperature is $H_{c,0} = 803$ G. The sample is located in liquid Helium at a temperature of $T = 4.2$ K.

- What is the critical field H_{cm} at this temperature ? Hint: use the empirical formula given in the lecture.
- Find the surface current flowing within a 1 cm wide band for an applied field equal to the critical field. Make a sketch of the problem.

2) Free energy gain and latent heat at phase transition

Consider a volume of 1 cm^3 of Pb. As known from exercise 1), the critical temperature of lead is $T_c = 7.2$ K and its critical field at zero temperature is $H_{c,0} = 803$ Oe. Calculate the

- free energy, $\Delta F = F_n - F_s$, and
- the latent heat, Q ,

of this amount of lead for a phase transition occurring at a temperature of 4.2 K.

3) Visualizing field penetration

Explain briefly two methods by which you can visualize superconducting and normal areas on a plane surface of a sample in the intermediate or mixed state.