Projektplan

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0.1 Introduction

The laboratory *Electrical conductivity* in the courses *Solid State Physics* was upgraded from an old set-up using; a cryo system, with heat controller; a series of power supplies; a black box with measurement circuits; a bench multimeter and an ancient computer system running on MS-DOS. The upgrades consisted of removing the external power supplies, the black box and exchanging the computer for a newer laptop and the user interface, *Elledn*, was remade in Labview.

The purpose of the the laboratory is to investigate how the electrical conductivity of different materials behaves in the temperature region $10-300$ K. The materials are a semi-conductor, InSb, a metal, Pt, and a super conductor, $YBa_2Cu_3O_7$.

1 The set-up

Equipment consist of:

- Cryogenic system:
  - Cooling chamber
  - Coarse vacuum pump
  - turbo molecular pump
  - Cryogenic system(compressor w. cooling system): HC-2, APD Cryogenics Inc.
- Controllers to cryogenic system:
  - Turbotronic NT10
  - Thermovac TM20
  - Scientific Instruments Inc. 9620-1 Silicon Diode
- Bench Multimeter: Keithley 2001 Multimeter
- Computer with Labview.

The materials are placed in the cooling chamber and the two vacuum pumps reduces the pressure to below 10^{-5} Pascal. This reduces the amount of heat that needs to be removed to change the chambers temperature.

≈ 10 K is the lowest temperature for the cooling part of the cryogenic equipment, which removes heat at a constant pace. An external heater is

Table 1: *Pin layout for connection cables between cooling chamber and multimeter.*

25-pin D-sub	round 19-pin connector	Function		
1	A	Superconductor	Current	+
2	B	”	”	-
3	C	”	Voltage	+
4	D	”	”	-
5	E	Pt-100	Current	+
6	F	”	”	-
7	G	”	Voltage	+
8	H	”	”	-
9	J	InSb-plate	Current	+
10	K	”	”	-
11	L	”	Voltage	+
12	M	”	”	-
13	N	Temperature diode	Current	+
14	P	”	”	-
15	R	”	Voltage	+
16	S	”	”	-
17	T	free		
18	U	free		
25	V	Shield		

used to alter the temperature by adding heat to the system. This heater is controlled by *Scientific Instruments Inc. 9620-1 Silicon Diode*. Which in turn can be controlled by a computer through an GPIB-interface.

The controller determines the heating with the aid of en equation consisting of an integral and a differential term. To improve the performance and responsiveness of the cryogenic equipment in various ranges, these terms can be changed by the user. For more information see the *Scientific Instruments Inc. 9620-1 Silicon Diode manual*.

To determine the resistivity of the samples, each sample is connected to a 4 sense wire system. These sense wires are connected to a Keithley 2001 Multimeter through a switching card at the back. The multimeter is also equipped with a GIPB-interface, enabling computer controlled measurements.

The connections from the samples and an additional temperature diode, goes first a through a round 19 pin contact to an 25 pin d-sub connector. See table 1 for pin layout on the cables.

2 Software

The software, ResSolidLabV1, is written in Labview and it can send the desired temperature to the

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