

Conduction in Non-Crystalline Materials

SIR NEVILL MOTT

*Emeritus Professor of Physics,
Cavendish Laboratory, University of Cambridge*

Physikalische Bibliothek
Fachbereich 6
Technische Hochschule Darmstadt
Hochschulstraße 2
D-6100 Darmstadt

CLARENDON PRESS · OXFORD

1987 TF 2703

Theoretische Festkörperphysik
Technische Hochschule
Darmstadt

Contents

1. Introduction	1
1.1. Conduction in crystalline systems	1
1.2. Non-crystalline systems	5
2. Transport in liquid and amorphous metals; weak-scattering systems	8
2.1. Introduction	8
2.2. Liquid metals	9
2.3. Mobility of electrons in liquid rare gases	12
2.4. Amorphous metals and metallic glasses	14
3. Short mean free paths and localization	18
3.1. The Kubo–Greenwood formula	18
3.2. Anderson localization and the mobility edge	20
3.3. Hopping conduction	27
3.4. The scaling theory of Abrahams <i>et al.</i>	29
3.5. The pre-exponential factor and minimum metallic conductivity	31
3.6. Thermopower	34
4. Heavily doped semiconductors	39
4.1. Uncompensated semiconductors; the Mott transition	39
4.2. Impurity conduction; the observed behaviour	44
4.3. Some effects on the Anderson transition of long-range interaction between electrons	46
5. Effects of interaction in amorphous metals	51
6. Polarons	55
6.1. Introduction	55
6.2. The Holstein polaron	55
6.3. Polarons in ionic crystals	59
6.4. Observations of small polarons	61
6.5. The rate of formation of polarons	66

6.6. Bipolarons	67
6.7. Polarons in non-crystalline materials	69
7. Amorphous semiconductors	71
7.1. Introduction	71
7.2. States in the gap; hydrogenization and doping	74
7.3. Experimental investigation of the density of states in the gap	79
7.4. Conductivity and thermopower	79
7.5. Drift mobility	84
7.6. Chalcogenides; valence alternation pairs	86
7.7. Photoconduction and recombination	88
8. Liquid semiconductors and metal–insulator transitions in liquids	92
9. Vitreous silicon dioxide	100
9.1. Electronic structure	100
9.2. Defects	103
9.3. Oxidation of silicon	104
10. Two-dimensional problems	107
10.1. Conductivity	107
10.2. Quantum Hall effect	113
References	114
Subject index	123
Author index	125