

Quasielastic Neutron Scattering for the Investigation of Diffusive Motions in Solids and Liquids

TASSO SPRINGER

Contents

1. Introduction	2
2. Scattering Theory	4
2.1 Differential Scattering Cross Sections	5
2.2 Van Hove's Theory	8
2.3 Asymptotic Behaviour of the Correlation Functions	14
2.4 Remarks on the Sum Rules	18
3. Methodical and Experimental Aspects	19
3.1 Frequency and Wave-Number Range; Resolution and Intensity	19
3.2 Instruments	22
3.3 Corrections	26
3.4 Separation of S_{coh} and S_{inc}	27
4. Monoatomic Liquids with Continuous Diffusion	28
4.1 The Langevin Equation	29
4.2 Oscillatory Diffusion	31
4.3 The Memory Function Concept	35
4.4 Computer Experiments	36
4.5 Experiments on Liquid Sodium and Argon	38
5. Jump Diffusion in Liquids	41
5.1 Theoretical Models	41
5.2 Experiments on Water	45
5.3 Difference between Continuous and Jump Diffusion	47
6. Diffusion of Hydrogen in Metals	50
6.1 Theoretical Models	51
6.2 Experiments	55
7. Rotational Diffusion in Molecular Solids	58
7.1 Jump Models with Equilibrium Orientations Determined by Crystal Symmetry	62
7.2 Description by Orientational Correlation Functions	64
7.3 Experiments	69
8. Molecular Liquids	71
8.1 Remarks on Theory	71
8.2 Experiments	72

9.	Polymeres and other Complicated Systems	76
9.1	Polymeres	76
9.2	Different Kinds of Water	79
10.	Effects of Coherent Scattering	81
10.1	Hydrodynamic Description	81
10.2	Influence of the Liquid Structure	82
11.	Quasielastic Scattering and other Methods	87
11.1	Various Kinds of Scattering Experiments	87
11.2	Relaxation Methods	90
11.3	Mössbauer Effect	93
	References	94

