

Contents

List of Symbols	9
Introduction	13
1. Interaction between Colloidal Particles	14
1.1. Electrical Double Layer Interaction	14
1.2. Van der Waals Interaction Energy	20
1.3. Steric Interaction (Structural Forces) Arising from Adsorbed Molecules	26
1.4. Superposition of the Interparticle Forces	31
2. Diffusion of Colloidal Particles	38
2.1. Translational Diffusion of Isolated Colloidal Particles	38
2.2. Translational Diffusion of Interacting Particles	41
2.2.1. Translational Diffusion without Electrostatic Repulsion Forces	41
2.2.2. Translational Diffusion Including Hydrodynamic Interaction	43
2.2.3. Translational Diffusion in the Presence of Electrostatic Repulsion Forces — Weak Coagulation Due to an Energy Barrier	47
2.2.4. Translational Diffusion under the Condition of Reversible Coagulation in the Primary or Secondary Minimum	50
2.2.5. Translational Diffusion in Polydisperse Systems	52
2.2.6. Translational Diffusion of Nonspherical Particles	53
2.2.7. Direct Measurements of Translational Diffusion Coefficients	55
3. Coagulation kinetics	58
3.1. Von Smoluchowski's Theory of Rapid Coagulation	58
3.2. Corrections to the Von Smoluchowski Theory for Polydispersity	61
3.3. Correction to the Von Smoluchowski Theory for Slow Coagulation	63
3.4. Introduction of Reversibility into Coagulation Kinetics	64
3.5. Rate Effect in Particle Collisions	76
3.6. Methods of Investigating Coagulation Kinetics	78
3.6.1. Ultramicroscopy	78
3.6.2. Coulter Counter	89
3.6.3. Measurement of the Volume Scattering in Colloidal Dispersion	89
3.6.4. Electro-optical phenomena in Colloidal Dispersions	92
3.6.5. Number Fluctuation Spectroscopy	94

3.7.	Experiments on Coagulation Kinetics	95
3.7.1.	Experiments on Rapid Coagulation.....	95
3.7.2.	Experiments on Slow Coagulation	110
3.7.3.	Experiments on the Kinetics of Bridging Flocculation.....	125
4.	Structure Formation in Disperse Systems.....	127
4.1.	Formation of Coagulation Structure by Attractive Forces	130
4.1.1.	Coagulation Structures Formed by Anisotropic Particles	136
4.1.2.	Structure in Dispersions of Spherical Particles	138
4.1.2.1.	Direct Modeling of Structures	140
4.1.2.2.	Computer Simulation of Structure Formation.....	142
4.1.2.3.	Conclusions	145
4.1.3.	Kinetics of Coagulation-Structure Formation	146
4.2.	Periodic Structures Formed by Repulsive Forces	149
4.2.1.	Short-Range Periodic Structures	150
4.2.2.	Long-Range Periodic Structures.....	153
4.3.	Formation of Structures under the Influence of External Forces	155
4.3.1.	Electrical Fields.....	155
4.3.2.	Magnetic Fields.....	156
4.3.3.	Mechanical Fields (Gravity, Centrifugation, Shear)	158
4.4.	Rheological Behavior of Structured Dispersions	160
4.4.1.	Types of Rheological Investigations	160
4.4.2.	Viscous Behavior of Coagulation Structures	163
4.4.3.	Elastic Behavior of Coagulation Structures	169
4.4.3.1.	Creep Measurements	170
4.4.3.2.	Compression of Structured Dispersions	178
References	183
Index	192