

Contents

1. Non-equilibrium Thermodynamics and Rheology.	1
1.1 A Short Review of Rheological Concepts.	2
1.2 Extended Irreversible Thermodynamics.	10
1.3 Rational Extended Thermodynamics.	17
1.4 Theories with Internal Variables.	23
1.5 Hamiltonian Formulations.	27
References.	32
2. Ideal Gases.	35
2.1 Review of Some Basic Concepts.	36
2.2 Information Theory.	37
2.3 Identification of Lagrange Multipliers.	46
2.4 Kinetic Theory.	49
2.5 Grad's Solution.	52
2.6 Comparison with Exact Results.	55
2.7 Partition Function for a Non-equilibrium Relativistic Ideal Gas.	58
References.	59
3. Non-ideal Fluids.	61
3.1 Modified Equations of State and Shift of the Critical Point.	62
3.2 Kinetic Theory of Dilute Non-ideal Gases.	67
3.3 Comparison with Computer Simulations.	72
3.4 Nuclear Collisions.	77
References.	81

4. Polymeric Solutions.	83
4.1 Kinetic Theory of Dilute Polymeric Solutions.	84
4.2 Derivation of the Steady-State Compliance.	95
4.3 Maximum-Entropy Approach.	98
4.4 Reptation Model.	99
References.	102
5. Non-equilibrium Chemical Potential and Shear-Induced Effects	103
5.1 Survey of Experimental Results.	104
5.2 Equilibrium Chemical Potential.	107
5.3 Non-equilibrium Chemical Potential.	110
5.4 Phase Diagram Under Non-equilibrium Conditions.	114
5.5 Non-equilibrium Effects in Non-Newtonian Fluids.	119
5.6 Other Approaches.	128
References.	131
6. Comparison of Thermodynamical and Dynamical Approaches.	133
6.1 Dynamical Derivation of Thermodynamical Stability Criteria.	134
6.2 Structure Factor.	139
6.3 Derivation of the Structure Factor.	143
References.	150
7. Thermodynamic Couplings Between Flow and Diffusion.	151
7.1 Introduction: Purely Dynamical Couplings.	152
7.2 Shear-Induced Migration of Polymers.	154
7.3 Thermodynamics of Taylor Dispersion.	164
7.4 Thermodynamics of Anomalous Diffusion.	170
References.	176
8. Chemical Reactions and Polymer Degradation Under Flow.	177
8.1 Thermodynamic Formulation.	178
8.2 Shear-Induced Polymer Degradation: Kinetic Analysis.	180

8.3 Shear-Induced Polymer Degradation: Thermodynamic Analysis.	184
8.4 Kinetic Theory of Chemical Reactions.	189
8.5 Recurrence Method for Probability Weight Distribution Under Viscous Pressure.	193
References.	195
9. Concluding Remarks and Perspectives.	197
9.1 Some Possible Criticisms.	197
9.2 Perspectives.	200
References.	202
Appendices	
A. Survey of Experimental Information	205
A.1 Polystyrene Dioctyl-Phthalate (PS/DOP).	205
A.2 Polystyrene Transdecalin (PS/TD).	206
A.3 Polystyrene Dissolved in Oligomeric Polystyrene.	208
References.	209
B. Liquid Crystals	211
B.1 Equilibrium Thermodynamics and the Isotropic-Nematic Phase Transition . . .	211
B.2 Dynamic Equations in the Presence of a Flow.	215
B.3 Thermodynamic Formulation.	218
B.4 Maximum-Entropy Approach	219
References.	221
C. Summary of Vector and Tensor Notation	223
D. Useful Integrals in the Kinetic Theory of Gases.	227
E. Some Physical Constants.	228
Subject Index.	229