

CONTENTS

1	Heat Capacity	3
1.1	Basic Concepts of the Heat Capacity of Solids	3
1.2	Temperature Dependence of Heat Capacity of Polymers	6
1.3	Temperature Transitions and Heat Capacity	28
2	Thermal Conductivity	43
2.1	Basic Concepts of Thermal Conductivity of Solids	43
2.2	Temperature Dependence of Thermal Conductivity of Polymers	45
2.3	Effects of Molecular Parameters	56
2.4	Anisotropy of Thermal Conductivity – Effect of Orientation	59
2.5	Effect of Radiation	65
2.6	Effect of Pressure	66
2.7	Thermal Conductivity of Filled Polymer Materials	67
2.8	Thermal (Temperature) Diffusivity	70
	References	72
3	Thermal Expansion	75
3.1	Basic Concepts of Thermal Expansion of Solids	75
3.2	Equation of State of Polymers	76
3.3	Gruneisen Parameters of Polymers	79
3.4	Thermal Expansion of Polymeric Crystals	84
3.5	Thermal Expansion of Drawn Polymers	94
3.6	Thermal Expansion of Filled Polymers and Polymer – Matrix Composites	101
	References	105
4	Experimental Methods and Instrumentation	107
4.1	Heat Capacity	107
4.2	Thermal Conductivity and Diffusivity	110
4.3	Thermal Expansion	121
	References	122

Part Two: Thermal Behavior of Polymers under Mechanical Deformation and Fracture

5	Thermomechanics of Glassy and Crystalline Polymers	127
5.1	Phenomenological Aspects of Quasi-Isotropic of Elastic Materials	128
5.2	Linear Thermomechanics of Quasi-Isotropic Hoolean Solids	130
5.3	The Thermoelastic Effect in Glassy and Crystalline Polymers	134
5.4	Thermomechanics of the Undrawn Glassy and Crystalline Polymers	137
5.5	Thermomechanics of Drawn Polymers	141
5.6	Microphase-Separated Block Copolymers with a Solid Matrix	158
5.7	Filled Solid Polymers	160
5.8	Biopolymers	160
	References	161
6	Thermomechanics of Molecular Networks and Rubberlike Materials	163
6.1	Thermomechanics of Molecular Networks (Theory)	163
6.2	Thermomechanics Behavior of Molecular Networks	175
6.3	Thermomechanics Behavior of Rubberlike Materials	189
	Appendix Thermomechanics of the New Models of Rubber Elasticity	203
	References	206
7	Thermodynamic Behavior of Solid Polymers in Plastic Deformation and Cold Drawing	211
7.1	Temperature Effects During Plastic Deformation and Cold Drawing of Glass and Crystalline Polymers	212
7.2	Thermodynamics of Plastic Deformation and Cold Drawing of Glassy and Crystalline Polymers	225
7.3	Thermal Behavior of Cold Drawn and Plastically Deformed Glassy and Crystalline Polymers and the Nature of the Stored Energy	233
7.4	Thermomechanical Behavior of Hard Elastic Fibers and Films	244
	References	246
8	Thermal Behavior of Solid Polymers Under Fracture	249
8.1	Thermal and Temperature Effects Resulting from the Formation and Growth if Cracks in Solid Polymers	249
8.2	Energetics of Chain Rupture in Stresses Polymers	259
8.3	Self-Heating During Cyclic Deformation and Thermal Fatigue Failure	268
	References	270

9	Experimental Methods and Instrumentation	271
9.1	Measurements of the Temperature Changes During Deformation	271
9.2	Temperature Dependence of Stresses (Isometric Measurements)	282
9.3	Deformation Calorimetry (Isothermal Measurements)	284
9.4	Calorimetric Methods for Investigating the Energy State of Deformation Polymers	291
	References	295
	Subject Index	297