| Preface Acknowledgements | | ix xiii |
|-----------------------------|--|------------|
| 1 | Introduction | 1 |
| 1.1 1.2 | Concepts associated with shape memory materials Principle of temperature-dependent shape memory | 1 |
| | polymers | 12 |
| 1.3 | Applications of shape memory polymers | 15 |
| 1.4 | Prospects for shape memory polymers | 23 |
| 1.5 | References | 25 |
| 2 | Preparation of shape memory polymers | 28 |
| 2.1 | Structures of shape memory polymers | 28 |
| 2.2 | Synthesis of shape memory polymers | 39 |
| 2.3 | Preparation of shape memory polymers for medical uses | 53 |
| 2.4 | References | 59 |
| 3 | Characterization techniques for shape memory | |
| | polymers | 62 |
| 3.1 | Differential scanning calorimetry | 62 |
| 3.2 | Wide angle X-ray diffraction | 69 |
| 3.3 | Dynamic mechanical thermal analysis | 77 |
| 3.4 | Fourier transform infrared | 84 |
| 3.5 | Raman spectroscopy | 87 |
| 3.6 | Gel permeation chromatography | 93 |
| 3.7 | Polarizing microscopy | 93 |
| 3.8 | Transmission electron microscopy | 99 |
| 3.9 | Scanning electron microscopy | 104 |
| 3.10 | Positron annihilation lifetime spectroscopy | 104 |
| 3.11 | Vapor transport property | 107 |
| 3.12 | References | 109 |

| vi | Contents |
|----|----------|
| | |

| 4 | Structure and properties of shape memory polyurethane ionomer | 113 |
|-----------------|--|------------|
| 4.1 | Morphology of crystalline soft segment in shape memory | |
| 7.1 | polyurethane ionomer | 114 |
| 4. 2 | Thermal properties of shape memory polyurethane ionomer | 117 |
| 4.3 | Isothermal crystallization kinetics of the soft segment in | |
| | shape memory polyurethane ionomer | 123 |
| 4.4 | Analysis of crystallization activation energy of soft segment | |
| | crystallization in shape memory polyurethane ionomer | 128 |
| 4.5 | Effect of ionic groups on equilibrium melting temperature | 132 |
| 4.6 | Dynamic mechanical property of shape memory | 126 |
| 4.7 | polyurethane ionomer | 136 140 |
| 4.7 | Infrared absorption analysis Shape memory effect of shape memory polyurethane | 140 |
| 4.0 | ionomer | 145 |
| 4.9 | References | 145 |
| 7.7 | References | 157 |
| 5 | Water vapor permeability of shape memory | |
| | polyurethane | 160 |
| 5.1 | Factors affecting water vapor permeability of SMPU | 160 |
| 5.2 | Factors affecting equilibrium sorption and dynamic | |
| | sorption of SMPU | 173 |
| 5.3 | Dependence of WVP through SMPU membranes on | |
| | temperature | 179 |
| 5.4 | Dependence of free volume of SMPU on temperature | 189 |
| 5.5 | References | 195 |
| 6 | Characterization of shape memory properties in | |
| 0 | polymers | 197 |
| 6.1 | Parameters for characterization | 197 |
| 6.2 | Measurements of parameters | 201 |
| 6.3 | Effect of thermomechanical cyclic conditions | 201 |
| 6.4 | Effect of sample preparation | 208 |
| 6.5 | References | 216 |
| 7 | Structure modeling of change memory polymore | 210 |
| | Structure modeling of shape memory polymers | 218 |
| 7.1 | Structural skeleton of SMPs | 218 |
| 7.2 | Structural categorization of SMPs | 219 |
| 7.3 | SMPs and traditional polymers | 225 |
| 7.4 | Considerations for molecular design of SMPs | 228 |
| 7.5 | Relationship between structure and property of SMPUs | 228 |
| 7.6 7.7 | Modeling of SMPs References | 238 249 |
| 1.1 | NCICICUCS | 249 |

•

| 8 | Environmentally sensitive polymer gel and its application in the textiles field | 252 |
|------------|--|-----|
| | | - |
| 8.1 8.2 | Environmentally sensitive polymer gel Application of environmentally sensitive polymer gel to | 252 |
| | textiles | 258 |
| 8.3 | References | 277 |
| 9 | Evaluation of shape memory fabrics | 279 |
| 9.1 | Shape memory and wrinkle-free fabrics | 279 |
| 9.2 | Evaluation methods for shape memory fabrics | 280 |
| 9.3 | Subjective method for characterizing shape memory | |
| | fabrics | 284 |
| 9.4 | Objective method for characterizing shape memory fabrics | 290 |
| 9.5 | Effect of temperature on shape memory effect | 299 |
| 9.6 | Conclusion | 303 |
| 9.7 | References | 303 |
| 10 | Shape memory textiles | 305 |
| 10.1 | Shape memory fibers | 305 |
| 10.2 | Role of smart materials in textiles | 326 |
| 10.3 | Shape memory material used in smart fabrics | 327 |
| 10.4 | Shape memory garments – active structure for fashion | |
| | apparel | 334 |
| 10.5 | References | 336 |
| | Index | 339 |