

Contents

Preface — V

Preface from authors — VII

Chapter 1

Introduction — 1

- 1.1 Spacecraft thermal control and thermal control films — 1
- 1.2 Classification and characteristics of thermal control thin films — 3
- 1.3 Fundamentals of thermal control thin film technology — 6
- 1.4 Space environment suitability of thermal control thin films — 14

Chapter 2

Single-structure passive thermal control films — 18

- 2.1 Germanium-coated polyimide thermal control film (Ge/Kapton) — 18
- 2.2 Multilayer insulation reflective screen thermal control film — 30
- 2.3 SiO₂ thermal control film — 32
- 2.4 TiAlN thermal control film — 37
- 2.5 High thermal conductivity diamond film — 46
- 2.6 Black thermal control film — 62
- 2.7 Advantages, disadvantages, and applicability of single-structure thermal control films — 67

Chapter 3

Multilayer composite structure passive thermal control film — 68

- 3.1 Glass-type secondary surface mirror — 68
- 3.2 Flexible secondary surface mirror — 77
- 3.3 Metal-ceramic composite thermal control film — 84
- 3.4 CCaG/CCAl optical multilayer composite thermal control film — 94
- 3.5 Advantages, disadvantages, and applicability of composite structure passive thermal control films — 101

Chapter 4

Intelligent thermal control thin films — 103

- 4.1 Vanadium dioxide intelligent thermal control film — 103
- 4.2 Rare-earth manganese oxides doped intelligent thermal control film — 112
- 4.3 Electrochromic thermal control device — 121
- 4.4 Advantages, disadvantages, and applicability of intelligent thermal control films — 127

Chapter 5

Micros-machined thermal control thin-film devices — 129

- 5.1 MEMS thermal shutters — 129
- 5.2 Microthermal switch radiators — 161
- 5.3 Thin-film electric heater — 189

Chapter 6

Preparation, characterization, and detection of thermal control thin films — 195

- 6.1 The preparation of thermal control thin films — 195
- 6.2 Characterization of thermal control thin films — 232
- 6.3 Measurement of thermal properties — 250

Chapter 7

Test technique for thermal control thin films — 263

- 7.1 Ground environmental tests — 263
- 7.2 Single factor simulated space environmental tests — 264
- 7.3 Combined environment test facility — 269

References — 271

Index — 275