ELECTRONIC MATERIALS AND PROCESSES HANDBOOK

Charles A. Harper Editor
Technology Seminars, Inc. Lutherville, Maryland

Ronald N. Sampson Editor
Technology Seminars, Inc. Murrysville, Pennsylvania

Second Edition

McGraw-Hill, Inc.
New York San Francisco Washington, D.C. Auckland Bogotá
Caracas Lisbon Madrid Mexico City Milan
Montreal New Delhi San Juan Singapore
Sydney Tokyo Toronto

CONTENTS

Contributors ix
Preface xi

Chapter 1. Plastics, Elastomers, and Processing for Electronics ***William M. Alvino*** **1.1**

1.1. Introduction *1.1*
1.2. Fundamentals *1.2*
1.3. Thermoplastics *1.14*
1.4. Thermoplastic Alloys and Blends *1.34*
1.5. Thermosets *1.34*
1.6. Elastomers *1.50*
1.7. Organic Coatings *1.55*
1.8. Polymer Processing *1.57*

Chapter 2. Printed-Wiring Boards ***Victor J. Brzozowski and Carl T. Brooks*** **2.1**

2.1. Introduction *2.1*
2.2. Printed-Wiring-Board System Types *2.2*
2.3. Materials for Printed-Wiring Boards *2.11*
2.4. Fabrication Processes for Printed-Wiring Boards *2.67*

Chapter 3. Ceramics, Glasses, and Diamonds ***Douglas M. Mattox*** **3.1**

3.1. Introduction *3.1*
3.2. Physical and Electrical Tests and Measurements *3.1*
3.3. Ceramics *3.2*
3.4. Glasses *3.19*
3.5. Glass-Ceramics *3.36*
3.6. Low-Fire Ceramic Substrates *3.36*
3.7. Ceramic and Glass Sealing *3.39*
3.8. Glazes *3.42*
3.9. Diamond *3.42*

Chapter 4. Semiconductor Materials ***R. Noel Thomas and Albert A. Burk, Jr.*** **4.1**

4.1. Properties of Semiconductors *4.1*
4.2. Bulk Semiconductor Crystal Growth *4.32*
4.3. Wafer Preparation *4.59*
4.4. Active-Layer Formation *4.66*

Chapter 5. Metals ***Don E. Harrison and John D. Harrison*** **5.1**

5.1. Introduction *5.1*
5.2. Characteristics of Metals *5.1*
5.3. Comparative Data on Metals *5.4*
5.4. Corrosion *5.10*
5.5. Applications of Metals in Electronics *5.16*

Chapter 6. Wire and Cable ***Edward J. Croop*** **6.1**

6.1. Introduction *6.1*
6.2. Wire Conductors *6.2*
6.3. Wire and Calbe Insulation *6.10*
6.4. Thermal Stability and Thermal Ratings of Insulation *6.15*
6.5. Shielding *6.16*
6.6. Design Considerations *6.20*
6.7. Interconnection and Hookup Wire *6.26*
6.8. Coaxial Cables *6.36*
6.9. Multiconductor Cables *6.43*
6.10. Magnet Wire *6.52*
6.11. Wire and Cable Terminations *6.54*
6.12. Specification Sources *6.64*

Chapter 7. Metals Joining of Electronic Circuitry ***James F. Maguire*** **7.1**

7.1. Introduction *7.1*
7.2. Wire Bonding *7.2*
7.3. Soldering *7.13*
7.4. Welding *7.68*
7.5. Other Mechanical Joining Methods *7.71*

Chapter 8. Thin and Thick Films ***James J. Licari*** **8.1**

8.1. Introduction *8.1*
8.2. Substrate Materials for Thin and Thick Films *8.2*
8.3. Thin Films *8.23*
8.4. Thick Films *8.59*

Chapter 9. Electrodeposition: Materials and Processes ***Donald Baudrand*** **9.1**

9.1. Introduction *9.1*
9.2. Plating Printed Circuit (Printed Wiring) Boards *9.3*
9.3. Nonelectrolytic Deposition of Metals *9.12*
9.4. Testing of Plating Deposits *9.16*
9.5. Electroless Nickel Plating on Metallized Ceramic *9.16*
9.6. Design for Plating *9.21*
9.7. Electrodeposition of Metals *9.23*
9.8. Postplating Treatments *9.25*
9.9. Characteristics of Electrodeposited Coatings in General *9.25*
9.10. Stripping of Electrodeposits *9.28*
9.11. Mechanism of Corrosion *9.28*

9.12. Precious Metal Plating *9.38*
9.13. Nonprecious Metal Plating *9.41*
9.14. Other Plating and Surface-Finishing Processes *9.45*
9.15. Plating Solution Constituents and their Functions *9.47*
9.16. Preparation of Metal Substrate for Plating *9.50*
9.17. Basic Theory of Electroplating *9.51*
9.18. Specifications *9.54*

Chapter 10. Lithography and Photofabrication *Jurgen Diekmann* 10.1

10.1. Introduction *10.1*
10.2. General Considerations in Photofabrication *10.2*
10.3. Photosensitive Materials *10.17*
10.4. Important Photofabrication Applications *10.33*
10.5. Outlook *10.56*

Chapter 11. Advanced Electronic Packaging, Materials, and Processes *Stephen G. Konsowski* 11.1

11.1. Introduction *11.1*
11.2. Multichip Module Materials *11.2*
11.3. Package Materials *11.12*
11.4. Microwave Package Materials *11.15*
11.5. Power Hybrids *11.18*
11.6. Composites in Electronic Packaging *11.24*
11.7. Interconnects *11.31*

Index follows Chapter 11 I.1