

## Contents

### List of Contributors VII

- 1 **Introduction: LIGA and Its Applications** 1  
*Volker Saile*
- 2 **X-ray Masks for LIGA Microfabrication** 11  
*Yohannes Desta and Jost Goettert*
- 3 **Innovative Exposure Techniques for 3D Microfabrication** 51  
*Naoki Matsuzuka and Osamu Tabata*
- 4 **Hot Embossing of LIGA Microstructures** 69  
*Mathias Hecke and Matthias Worgull*
- 5 **Exposure and Development Simulation for Deep X-ray LIGA** 103  
*Jan G. Korvink, Sadik Hafizovic, Yoshikazu Hirai, and Pascal Meyer*
- 6 **Design for LIGA and Safe Manufacturing** 143  
*Ulrich Gengenbach, Ingo Sieber, and Ulrike Wallrabe*
- 7 **Commercialization of LIGA** 189  
*Ron A. Lawes*
- 8 **Polymer Optics and Optical MEMS** 205  
*Jürgen Mohr*
- 9 **Refractive X-ray Lenses Produced by X-ray Lithography** 233  
*Arndt Last*
- 10 **RF Applications** 243  
*Sven Achenbach and David M. Klymyshyn*
- 11 **Evolution of the Microspectrometer** 281  
*Reiner Wechsung, Sven Schönfelder, and Andreas Decker*

- 12 Actuator Manufacture with LIGA Processes** 297  
*Todd Christenson*
- 13 Development of Microfluidic Devices Created via the LIGA Process** 323  
*Masaya Kurokawa*
- 14 Application of Inspection Devices** 337  
*Yoshihiro Hirata*
- 15 The Micro Harmonic Drive Gear** 351  
*Reinhard Degen and Rolf Slatter*
- 16 Microinjection Molding Machines** 395  
*Christian Gornik*
- 17 Filled Resist Systems** 415  
*Thomas Hanemann, Claas Müller, and Michael Schulz*
- 18 Dramatic Downsizing of Soft X-ray Synchrotron Light Source from Compact to Tabletop** 443  
*Hironari Yamada, Norio Toyosugi, Dorian Minkov, and Yoshiko Okazaki*
- 19 PTFE Photo-fabrication by Synchrotron Radiation** 453  
*Takanori Katoh and Yanping Zhang*
- Index** 469