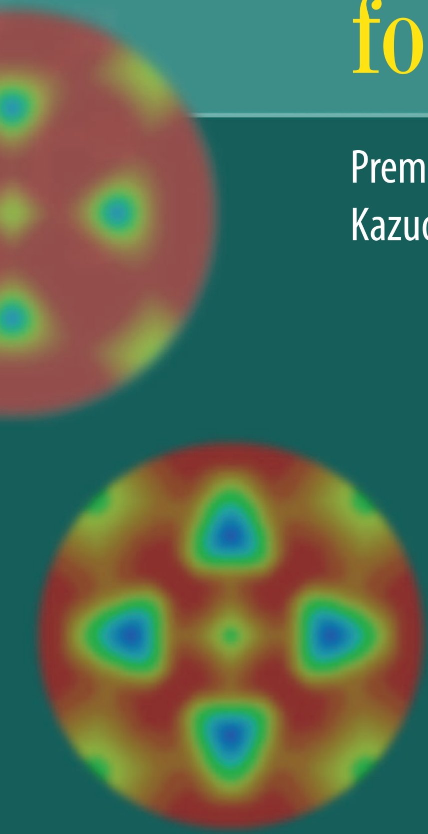
Silicon Wet Bulk Micromachining for MEMS

Prem Pal
Kazuo Sato



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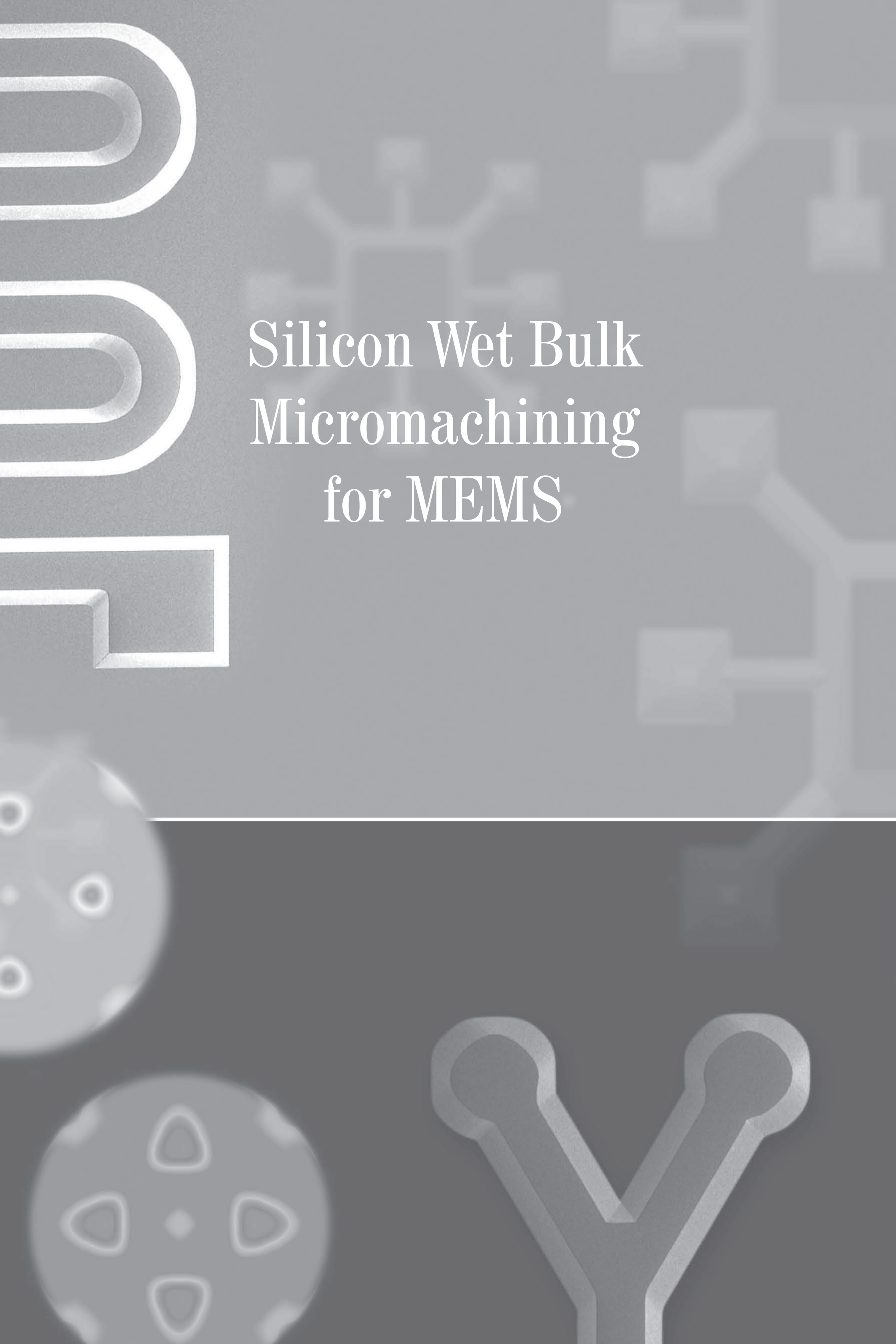

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Preface

Microelectromechanical systems (MEMS)-based sensors and actuators have become remarkably popular in the past few decades. Rapid advances have taken place in terms of both technologies and techniques of fabrication of MEMS structures. Wet chemical–based silicon bulk micromachining continues to be a widely used technique for the fabrication of microstructures used in MEMS devices. Researchers all over the world have contributed significantly to the advancement of wet chemical–based micromachining, from understanding the etching mechanism to exploring its application to the fabrication of simple to complex MEMS structures. In addition to its various benefits, one of the unique features of wet chemical–based bulk micromachining is the ability to fabricate slanted sidewalls, such as 45° walls as micromirrors, as well as freestanding structures, such as cantilevers and diaphragms. This makes wet bulk micromachining necessary for the fabrication of structures for myriad applications. Considering the importance of wet bulk micromachining in the fabrication of MEMS, all that we wanted to do is to write a deep book that can cover topics from the basic to the advanced level and can be used as a reference and as a textbook.

This book provides a comprehensive understating of wet bulk micromachining for the fabrication of simple to advanced microstructures for various applications in MEMS. It includes introductory to advanced concepts and covers research on basic and advanced topics on wet chemical–based silicon bulk micromachining. The book thus serves as an introductory textbook for undergraduate- and graduate-level students of physics, chemistry, electrical and electronics engineering, materials science, and engineering, as well as a comprehensive reference for researchers working or aspiring to work in the area of MEMS and for engineers working in microfabrication technology.

To understand the wet anisotropic etching for silicon micromachining, an elementary understanding of crystallography is essential. Hence we have included a separate chapter to cover the basics of the crystal structure and stereographic projection.

In addition, a basic understanding of microfabrication techniques employed in semiconductor industries is required in order to explore wet bulk micromachining for the fabrication of MEMS components. Therefore, a separate chapter, "Brief Overview of Silicon Wafer Manufacturing and Microfabrication Techniques," is also included.

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We sincerely thank two distinguished contributors Prof. Irena Zubel (Wrocław University, Poland) for writing Section 4.2, Chapter 4, and Mr. Sajal Sagar Singh (IIT Hyderabad, presently at the University of Michigan) for coauthoring Chapter 7. We are highly thankful to Ms. Michiko Shindo (secretary to Prof. Sato) for her assistance in obtaining permissions to reproduce a few figures from published papers. At Pan Stanford Publishing, we wish to thank Mr. Stanford Chong for inviting us to write a book on silicon bulk micromachining and his team that has helped in refining the material in this book and extended all possible support at every stage of the manuscript.
We welcome comments or suggestions on this textbook by email at prem@iith.ac.in and sato@aitech.ac.jp.

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