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Silicon Carbide Microsystems for Harsh Environments

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This book is affectionately dedicated to my beloved parents for teaching me courage and perseverance and believing in me when others doubted.

-M. B. J. Wijesundara

To Miles, Ava, and Chloe.

-R. G. Azevedo

Foreword

When I was approached by my good friends, Drs. Muthu Wijesundara and Robert Azevedo, to write a forward for their book, I was truly honored. Each had worked, yes even truly struggled, with me to master some part of the technology of silicon carbide in our group efforts to bring silicon carbide forward as a complete RF wireless sensor technology. From the prospective developed in my service as DARPA program manager, Mechanical Engineering Department Chair, fellow researcher and Dean of the College of Engineering, I do attest that this wonderful book will be useful to the practitioner as well as to the researcher in the field of silicon carbide. Indeed, it is required reading now in my own research laboratory for all who would work with me in the research of silicon carbide. I have worked hard for over ten years in the struggle to master silicon carbide, and I am pleased to report to the reader that this volume will certainly ease your way toward a true command of the subject. I have reviewed the volume in great detail, and I affirm that it is useful both to the neophytes, eager to enter the field, as well as to the experts, seeking to deepen their knowledge. As a long-time member of the research community, with twenty-eight years of service to the University of California, Berkeley, I affirm that there is no equivalent book available today. And I offer my thanks and gratitude to my good friends for making all the effort to compile this edition — they have more diligence and fortitude than I, who have not yet compiled any book of my own.

With sincerity and admiration,

University of California, Berkeley, March 2011 *Albert P. Pisano, Professor*

Preface

This book is intended for the practicing microelectromechanical sensor designer as well as engineers and engineering managers in other fields. This book provides an introduction to harsh environment sensor applications and silicon carbide microelectronics and microelectromechanical system technology for such applications. Namely, this book reviews why silicon carbide is an excellent match for producing harsh environment microsystems, how silicon carbide substrates and films are produced and patterned, review progress towards silicon carbide microelectronics and microelectromechanical sensors, and how electronics and microsensors can be integrated and packaged. Various approaches to communication and power are also discussed. It is hoped that by providing a review of the pieces of silicon carbide microsystem technology currently available and outlining additional innovations needed to produce reliable harsh environment microsystems, new research will address these challenges and the full benefit of silicon carbide microsystems will be realized.

We came into silicon carbide technology through our research at the University of California at Berkeley. We worked together on materials and electromechanical design of harsh environment sensors made from silicon carbide for the DARPA HERMIT project. We would like to thank Prof. Albert P. Pisano and Prof. Roya Maboudian for introducing us to this research.

Others have contributed to this manuscript, so we would like to offer our sincere thanks. Dr. David Myers, Dr. Anand Jog, and Raminderdeep Sidhu reviewed drafts of the manuscript and provided valuable input into the structure and flow. Steven Elliot facilitated various logistics and feedback throughout this process.

We would also like to give a special thank you to our families, who have been understanding of nights or weekends spent working on this book and whose support is, as always, what enables us to pursue our passions.

Arlington, Texas *Muthu B. J. Wijesundara*
Albany, California *Robert G. Azevedo*
March 2011

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