Preface

The 2003 International Conference on Characterization and Metrology for ULSI Technology was held at the J.J. Pickle Research Campus, University of Texas, Austin, TX, from March 24 through March 28, 2003. The conference was dedicated to summarizing major issues and giving critical reviews of important measurement techniques that are crucial to continue the advances in semiconductor technology. This conference was the fourth in a series; the first three were held at the National Institute of Standards and Technology, Gaithersburg, MD, in winter 1995, spring 1998, and summer 2000. Papers from those conferences were published in hardback proceedings by the American Institute of Physics, New York (www.aip.org).

The 2003 Conference brought together leaders, scientists, and engineers concerned with all aspects of technology, characterization techniques, and metrology for silicon research, including development, manufacturing, and diagnostics. Key, knowledgeable people in the semiconductor field addressed the unique metrology and characterization requirements of silicon IC development and manufacturing. Sessions on silicon ICs were based on the technology drivers in the International Technology Roadmap for Semiconductors.

The Editors believe that the invited talks, poster papers, panel, and informal discussions during the conference provided a basis for stimulating practical perspectives and ideas for research and development, as well as a chance to explore collaborations and interactions. The Editors feel that the conference and this book of collected papers provide a concise and effective portrayal of industry characterization needs and the way they are being addressed by industry, academia, and government to continue the dramatic progress in semiconductor technology.

The worldwide semiconductor community faces increasingly difficult challenges as it moves into the manufacturing of chips with feature sizes less than 100 nm. The magnitude of these challenges demands special attention from the metrology and analytical measurements community. New paradigms must be found to stimulate the development of new and improved measurement tools and techniques. Adequate research and development for new metrology concepts are urgently needed.

Robert Helms, former CEO and President of International SEMATECH, opened the conference with an examination of the future of semiconductor technology in his keynote talk. Helms looked toward the semiconductor industry enabling products in broadband and 3G wireless, products in voice recognition, biomedical electronics, and technologies in MEMS, nanotechnology, and biotechnology. The Plenary Session continued with Thomas Theis, IBM Yorktown, discussing “Nanotechnology: a Look into the Future.” Jim Hutchby, Semiconductor Research Corporation, followed with a look at “CMOS Devices and Beyond: a Process Integration Perspective.” Alain Diebold, International SEMATECH, concluded the session with a presentation on “Metrology and Characterization Requirements and Challenges Over the Next 15 Years.” These talks provided a larger context for the detailed discussions of semiconductor metrology and characterization issues in the conference program, which consisted of formal invited presentation sessions and poster sessions for contributed papers.

The invited talks provided overviews of major issues, as well as up-to-date reviews of the latest metrology and characterization techniques for semiconductor device research, development, and manufacturing. Poster papers, which were presented in three sessions, emphasized new developments and improvements in characterization technology.

The chairs of the invited paper sessions were Robert Doering, Texas Instruments; Rajinder Khosla, National Science Foundation; Marylyn Bennett, International SEMATECH; Joaquin Martinez, National Institute of Standards and Technology; Paul Ho, University of Texas; Robert McDonald, Metara, Inc.; Dick Hockett, Charles Evans and Associates; Robert Mazur, Solid State Measurements; Caroline
Ayre, Intel; and Dan Herr, Semiconductor Research Corporation.

On the final morning of the conference, a panel moderated by Robert Mazur, Solid State Measurements, and Mark Anthony, Omniprobe, led a discussion on the value of metrology. Paul Ho, University of Texas; Stefan Zollner, Motorola; Sam Harrell, Strategic Technology Advisors; and Thomas Shaffner, National Institute of Standards and Technology, served as panel members.

For the first time in the series, the conference committee organized a selection of short course tutorials. The titles and instructors are listed on the next page.

This proceedings volume is organized along the lines of the conference program. Similar to the topics of the invited paper sessions, the papers are grouped in major sections with specific topic headings: Integrated Circuit History, Challenges and Overviews, Front End, Lithography, Interconnect and Back End, and Critical Analytical Techniques. In addition, the Editors have added new manuscripts not presented at the conference by Nick Holonyak, Jr., University of Illinois at Urbana-Champaign (“Diffused Silicon Transistors and Switches (1954-55): The Beginning of Integrated Circuit Technology”); Takeshi Hattori, Sony Corp. (“Challenges of Finer Particle Detection on Unpatterned Silicon Wafers”); and Richard Matyi, National Institute of Standards and Technology (“High Resolution X-ray Scattering Methods for ULSI Materials Characterization”).

The Editors thank the members of the program committee, the session chairs, the panel members, and many of the invited speakers for their assistance in reviewing the manuscripts submitted for publication in this volume. They also thank the authors for their diligence in producing the camera-ready copies of their papers and in responding to reviewer comments and suggestions. Special thanks go to Intel, International SEMATECH, KLA-Tencor, Solid State Measurements, and Texas Instruments, sponsors of the wine and cheese poster sessions. More thanks go to Bede Scientific, Inc.; Bruker AXS; Cameca Instruments, Inc.; Jobin Yvon, Inc.; Technos International, Inc.; and Thermo VG Scientific, for their contributions as the conference series’ first exhibitors. Finally, the Editors especially thank Brenda Main, formerly of National Institute of Standards and Technology, and Jo Ann Smith, University of Texas, whose expert assistance greatly facilitated the planning and conduct of the conference. Their tremendous efforts truly contributed to a successful conference in the heart of Texas.

An evaluation survey was conducted following the conference. Respondents indicated that the conference had been meaningful and relevant for them because:

- the “choice of papers was excellent”
- they “loved content of talks, organization”
- it provided an “excellent quality of invited talks”
- “several overviews were very helpful”

One attendee summarized the conference philosophy in an unsolicited letter, stating that the conference provided “an excellent snapshot of the state of the art in metrology for the semi industry, showing new progress and pointing to the critical metrology needs ahead.”

Because of the overwhelming enthusiasm by the conference attendees, the conference committee co-chairs plan to hold a fifth conference in this series in approximately the 2005/2006 timeframe. If you would like to be on the organizing/program committee or become a sponsor, please contact David Seiler, Conference Committee Co-Chair, at 301-975-2054 or david.seiler@nist.gov.

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