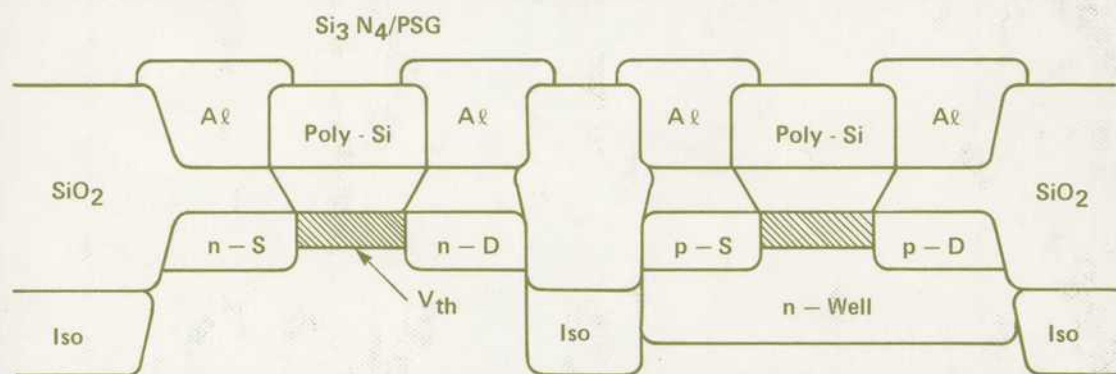
SILICON PROCESSING

D. C. GUPTA, editor



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SILICON PROCESSING

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San Jose, Calif., 19–22 Jan. 1982

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Foreword

The Symposium on Silicon Processing was held in San Jose, California, on 19–22 January 1982. ASTM Committee F-1 on Electronics, the National Bureau of Standards, and Stanford University sponsored the symposium, and Dinesh C. Gupta, Siliconix Incorporated, presided as chairman. The Advisory Board consisted of Kenneth E. Benson, Bell Laboratories; W. Murray Bullis, Fairchild Advanced R&D Laboratory; Robert E. Lorenzini, Siltec Corporation; Samuel L. Marshall, Solid State Technology; and James D. Meindl, Stanford University. The Technical Committee consisted of Theodore I. Kamins, Hewlett-Packard Laboratories; Eric Mendel, International Business Machines; Krishna C. Saraswat, Stanford University; Joseph Stach, Penn State University; and Fritz G. Vieweg-Gutberlet, Wacker Chemitronic; and was headed by Paul H. Langer, Bell Laboratories. The Arrangements and Publicity Committee consisted of Austin R. Blew, Lehighton Electronics Incorporated; Edward E. Gardner, IBM-GTD; Gilbert A. Gruber, Siliconix Incorporated; Charles Koehler, Fairchild Advanced R&D Laboratory; Donald J. Levinthal, Semiconductor International; Philip L. Lively, ASTM; David G. Mead, Nicolet Instrument Corporation; J. Timothy Raab, Rockwell International Recticon; Donald G. Schimmel, Bell Laboratories; and William R. Wheeler, Tencor Instruments; and was headed by Carl A. Germano, Motorola Incorporated. The Spouse Committee, consisting of Lou Ann Gruber, Vijay Gupta, and Carol Koehler, was headed by Kathleen Bullis; and the Registration Committee, consisting of Elaine Cohen, National Bureau of Standards, and Jan Meighan, San Jose Convention Bureau, was headed by Mr. Lively. We appreciate their efforts.

Appreciation is also extended to the following session and workshop chairmen: James T. Clemens, Bell Laboratories; James R. Ehrstein, National Bureau of Standards; Carl A. Germano, Motorola Incorporated; Gilbert A. Gruber, Siliconix Incorporated; Theodore I. Kamins, Hewlett-Packard Laboratories; William H. Kroeck, Western Electric Company; John W. Lampe, Martin Marietta Aerospace; Paul H. Langer, Bell Laboratories; Eric Mendel, International Business Machines; C. W. Pearce, Western Electric Company; R. Fabian W. Pease, Stanford University; Mike Powell, Motorola Limited; Sy Prussin, TRW Systems; Krishna C. Saraswat, Stanford University; Joseph Stach, Penn State University; and Fritz G. Vieweg-Gutberlet, Wacker Chemitronic.

Related ASTM Publications

Laser-Induced Damage in Optical Materials: 1979, STP 726 (1980), 04-726000-46

Lifetime Factors in Silicon, STP 712 (1980), 04-712000-46

Laser-Induced Damage in Optical Materials: 1978, STP 689 (1979), 04-689000-46

Optical Interferograms—Reduction and Interpretation, STP 666 (1979), 04-666000-46

Annual Book of ASTM Standards, Volume 10.04: Electronics (I), 01-100483-46

Annual Book of ASTM Standards, Volume 10.05: Electronics (II), 01-100583-46

A Note of Appreciation to Reviewers

The quality of the papers that appear in this publication reflects not only the obvious efforts of the authors but also the unheralded, though essential, work of the reviewers. On behalf of ASTM we acknowledge with appreciation their dedication to high professional standards and their sacrifice of time and effort.

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Preface

The papers in this volume were presented at the Symposium on Silicon Processing held in San Jose, California, on 19–22 January 1982. The symposium was sponsored by ASTM Committee F-1 on Electronics, the National Bureau of Standards, and Stanford University. In addition to the technical presentations, the symposium included well-attended workshops on each technical topic; impressions of these workshops are provided in Appendix II.

The trend towards very-large-scale integration (VLSI) is usually described as increasing device count on an integrated circuit chip. The associated trends towards smaller feature size, larger chip size, and larger wafer diameter present new problems in processing technology and control to the semiconductor device manufacturer. The symposium was designed to identify the future directions in materials and processing technology required for VLSI and areas where additional measurement development and standardization are required to accelerate the efficient implementation and control of these technologies.

The symposium opened with a series of brief talks on the role of standards and on the work performed by the Stanford Center for Integrated Systems, the National Bureau of Standards, and the National Science Foundation in relation to the semiconductor industry. These talks were followed by an overview projection of future VLSI technology which emphasized the need for rigorous and disciplined control of processes to achieve the potential of VLSI. These talks are presented in Appendix I.

The opening general session included a discussion on semiconductor business and education requirements in the Eighties by a panel of prominent individuals in industry, academia, and government. Brief summaries of the panel responses to key questions are provided in Appendix II.

The response to the symposium was extremely favorable, suggesting a continuing need for a regular forum to discuss technology topics in the context of measurement and control. Accordingly, the symposium sponsors have initiated plans both to repeat the symposium at two-year intervals and to broaden industry involvement in the organization and conduct of future symposia. The present symposium has established a consistent theme for these symposia as they evolve: understanding and control of the complex process technologies required for VLSI and other advanced device concepts. The problem areas and standardization needs identified in this and subse-

quent symposia will provide the feedback to the research community and voluntary standards system essential for the future growth of the industry.

We appreciate the cooperation and support of the ASTM staff in the formulation of these proceedings. The assistance of W. Murray Bullis is acknowledged. Finally, we are indebted to our industrial, government and university colleagues who contributed to the content of the symposium and the proceedings.

Contents

Introduction 1

CRYSTAL GROWTH AND MATERIAL SHAPING

Silicon Crystal Growth and Processing Technology: A Review—A. C. BONORA 5

Large-Diameter Czochralski Silicon Crystal Growth—W. LIN AND D. W. HILL 24

Impurity Incorporation in Czochralski Silicon Grown for VLSI—A. MURGAI 39

Dependence of Silicon Float-Zone Refining Parameters on Frequency—K. P. GUPTA AND R. O. GREGORY 50

Influence of Laser Marking on Silicon Wafer Properties—M. H. CHRIST AND B. S. MAURANTONIO 62

MICROELECTRONICS IMAGING AND PATTERNING

A Review of Optical Lithographic Techniques for VLSI—D. A. DOANE 85

Resist Profile Quality and Linewidth Control—A. R. NEUREUTHER 108

Considerations of Resist Processing—M. J. BOWDEN AND J. FRACKOVIAK 125

SILICON CVD TECHNIQUES

Epitaxy: An Introspective Review—J. H. WILLIAMS 147

Modeling and Applications of Silicon Epitaxy—G. R. SRINIVASAN 151

Effects of Processing Parameters on Shallow Surface Depressions During Epitaxial Deposition—M. R. BOYDSTON, G. A. GRUBER, AND D. C. GUPTA 174

Improvement in MOS VLSI Device Characteristics Built on Epitaxial Silicon—L. S. WHITE, G. R. MOHAN RAO, P. LINDER, AND M. ZIVITZ 190

Reduced-Pressure Chemical Vapor Deposition of Polycrystalline Silicon—M. L. HAMMOND 206

Plasma-Enhanced Chemical Vapor Deposition of Silicon and Silicon-Containing Films—D. W. HESS 218

DIELECTRICS AND JUNCTION FORMATION

Process Technology Requirements for VLSIC Fabrication—R. KUMAR, M. M. NOWAK, E. H. TYLER, AND M. A. VINSON 229

Defects and High-Pressure Steam Oxidation of Silicon—L. E. KATZ 238

Hydrogen/Chlorine Distributions in Silicon Dioxide: Detection and Model—J. R. MONKOWSKI, M. D. MONKOWSKI, I. S. T. TSONG, AND J. STACH 245

Dependence of Thin-Gate Oxide Properties on Processing—S. K. LAI 260

Polyimide-Substrate Effects During Wet Chemical Processing of Polyimide Films in VLSI—D. J. BELTON, P. VAN PELT, AND A. E. MORGAN 273

Modeling Anomalous Junction Formation in Silicon by the Codiffusion of Implanted Arsenic with Phosphorus—R. B. FAIR AND W. G. MEYER 290

DEFECTS, OXYGEN PRECIPITATION, AND CARRIER LIFETIME

Silicon Crystals for VLSI Technologies—L. JASTRZEBSKI 309

Material Defect Factors Affecting MOS Device Performance—J. H. MATLOCK 332

Oxygen Precipitation Studies at Various Impurity Levels Using Thermal Donor Activation—J. C. ALLISON, O. F. MAXWELL, R. SCHINDLER, AND M. DOMENICI 362

Effects of Oxygen Precipitation on Minority Carrier Lifetime in Silicon Crystals—C. J. VARKER, J. D. WHITFIELD, AND P. L. FEJES 369

Defects and Carrier Lifetime in Silicon—A. ROHATGI AND P. RAI-CHOUDHURY 389

MEASUREMENTS FOR PROCESS CONTROL

Computer-Aided Process Modeling for Design and Process Control—R. W. DUTTON, P. FAHEY, K. DOGANIS, L. MEI, AND H. G. LEE 407

Characterizing Process Nonuniformities on Large-Diameter Wafers: An Overview—D. S. PERLOFF 422

Temperature-Dependent Infrared Characterization of Silicon Wafers—D. G. MEAD, R. M. GUMMER, AND C. R. ANDERSON 445

Analysis of Infrared Spectra for Oxygen Measurements in Silicon—R. K. GRAUPNER 459

Determination of Oxygen Concentration in Silicon by Infrared Absorption—T. ABE, S. GOTOH, N. OZAWA, AND T. MASUI 469

Thickness Measurement of Thin (1.0-μm) Epitaxial Silicon Layers by Infrared Reflectance—S. P. WEEKS 477

Automated Detection of Wafer Surface Defects by Laser Scanning—L. K. GALBRAITH 492

Computerized Electron-Beam Linewidth Measuring and Inspection: A New Tool—T. F. POMPOSO AND V. J. COATES 501

Measurement of Ion Implantation Doses in Silicon by Ellipsometry and Spectral Reflectance—A. K. HOCHBERG 509

APPENDIXES

Appendix I

The Role of Standards in the Electronics Industry—K. E. BENSON 537

NBS Work for the Semiconductor Industry—R. I. SCACE 538

NSF Role in Microelectronics—R. J. GUTMANN 540

Future VLSI Technology: A Review—J. M. EARLY 541

Appendix II—Panel and Workshop Discussions: A Synopsis—D. C. GUPTA 547

Index 553