

PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 10310

, "Front Matter: Volume 10310," Proc. SPIE 10310, Technology of Proximal Probe Lithography, 1031001 (3 October 1993); doi: 10.1117/12.2283725

SPIE.

Event: SPIE Institutes for Advanced Optical Technologies 10, 1993, Bellingham, WA, United States

Table of Contents

ix *List of Contributors*

INTRODUCTION

- 3 **Technology of proximal probe lithography: an overview**
J. A. Dagata, National Institute of Standards and Technology;
C. R. K. Marrian, Naval Research Lab.
-

PART I. NANOLITHOGRAPHY

- 16 **Principles and techniques of STM lithography**
M. A. McCord, IBM Corp.; R. F. W. Pease, Stanford Univ.
- 33 **Role of scanning probe microscopes in the development of nanoelectric devices**
A. Majumdar, S. M. Lindsay, Arizona State Univ.
- 58 **Low voltage e-beam lithography with the STM**
C. R. K. Marrian, E. A. Dobisz, Naval Research Lab.; J. A. Dagata, National Institute of Standards and Technology
- 74 **Nanolithography and atomic manipulation on silicon surfaces by STM**
F. Grey, A. Kobayashi, H. Uchida, D. H. Huang, M. Aono, Aono Atomcraft Project (Japan)
- 100 **Scanning tunneling microscope-based fabrication and characterization on passivated semiconductor surfaces**
J. A. Dagata, J. Schneir, National Institute of Standards and Technology
- 111 **Scanning tunneling microscope-based nanolithography for electronic device fabrication**
J. W. Lyding, R. T. Brockenbrough, P. Fay, J. R. Tucker, K. Hess, Univ. of Illinois; T. K. Higman, Univ. of Minnesota
- 127 **Arrayed lithography using STM-based microcolumns**
T. H. P. Chang, IBM T.J. Watson Research Ctr.; L. P. Muray, Cornell Univ.; U. Staufer, Univ. of Basel (Switzerland); M. A. McCord, D. P. Kern, IBM T.J. Watson Research Ctr.
-

PART II. FABRICATION

- 162 **Nanofabrication by scanning probe instruments: methods, potential applications, and key issues**
R. Wiesendanger, Univ. of Basel (Switzerland)
- 188 **Direct writing of metallic nanostructures with the scanning tunneling microscope**
A. L. de Lozanne, W. F. Smith, E. E. Ehrichs, Univ. of Texas/Austin

Technology of Proximal Probe Lithography, edited by Christie R. K. Marrian,
Proc. of SPIE Vol. 10310 (Vol. IS10), 1031001 · © (1993) 2017 SPIE
CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2283725

- 200 **Fabrication of nanometer-scale structures**
M. H. Nayfeh, Univ. of Illinois/Urbana-Champaign
- 218 **Modification and manipulation of layered materials using scanned probe microscopies**
C. M. Lieber, Harvard Univ.
- 234 **Atomic force microscopy experimentation at surfaces: hardness, wear, and lithographic applications**
T. A. Jung, Univ. of Basel (Switzerland) and Paul Scherrer Institute (Switzerland); A. Moser, Univ. of Basel (Switzerland); M. T. Gale, Paul Scherrer Institute (Switzerland); H. J. Hug, U. D. Schwarz, Univ. of Basel (Switzerland)
- 268 **Fabrication and characterization using scanned nanoprobe**
G. C. Wetsel Jr., S. E. McBride, H. M. Marchman, Univ. of Texas/Dallas
- 289 **Ballistic electron emission microscopy: from electron transport physics to nanoscale materials science**
H. D. Hallen, AT&T Bell Labs.

PART III. METROLOGY

- 322 **Generating and measuring displacements up to 0.1 m to an accuracy of 0.1 nm: Is it possible?**
E. C. Teague, National Institute of Standards and Technology
- 364 **Metrology with scanning probe microscopes**
J. E. Griffith, AT&T Bell Labs.; D. A. Grigg, Digital Instruments;
G. P. Kochanski, M. J. Vasile, AT&T Bell Labs.; P. E. Russell, North Carolina State Univ.
- 390 **Metrology applications of scanning probe microscopes**
L. A. Files-Sesler, J. N. Randall, F. G. Celii, Texas Instruments Inc.

List of Contributors

M. Aono
Aono Atomcraft Project
Exploratory Research for Advanced
Technology
Japan Research Development Corp.
Tokodai 5-9-9
Tsukuba, Ibaraki 300-26, Japan

Roger T. Brockenbrough
Univ. of Illinois
Dept. of Electrical and Computer
Engineering
Urbana, IL 61801, USA

Francis G. Celii
Texas Instruments Inc.
MS 147
P.O. Box 655936
Dallas, TX 75265-5936, USA

T. H. Chang
IBM T.J. Watson Research Ctr.
Yorktown Heights, NY 10598, USA

John A. Dagata
National Institute of Standards and
Technology
Bldg. 220, Rm. A107
Gaithersburg, MD 20899-0001, USA

A. L. de Lozanne
Univ. of Texas/Austin
Physics Dept.
Austin, TX 78712-1020, USA

Elizabeth A. Dobisz
Naval Research Lab.
Electronics Science & Technology Div.
Code 6864
4555 Overlook Dr.
Washington, DC 20375-5347, USA

E. E. Ehrichs
Univ. of Texas
Dept. of Physics
Austin, TX 78712-1081, USA

Patrick Fay
Univ. of Illinois
Dept. of Electrical and Computer
Engineering
Urbana, IL 61801, USA

Leigh A. Files-Sesler
Texas Instruments Inc.
Central Research Labs.
MS 134
13588 N. Central Expwy.
Dallas, TX 75243-1108, USA

Michael T. Gale
Paul Scherrer Institute
Optics Group
Badenerstrasse 569
CH-8048 Zürich, Switzerland

François Grey
Aono Atomcraft Project
Exploratory Research for Advanced
Technology
Japan Research Development Corp.
Tokodai 5-9-9
Tsukuba, Ibaraki 300-26, Japan

Joseph E. Griffith
AT&T Bell Labs.
Rm. 6F-225
P.O. Box 636
Murray Hill, NJ 07974-0636, USA

David A. Grigg
Digital Instruments
520 E. Montecito
Santa Barbara, CA 93103-3252

Hans D. Hallen
North Carolina State Univ.
Dept. of Physics
P.O. Box 8202
Raleigh, NC 27695-8202, USA

Karl Hess
Univ. of Illinois
Beckman Institute
405 North Mathews Avenue
Urbana, IL 61801-2325, USA

T. K. Higman
Univ. of Minnesota
Dept. of Electrical Engineering
200 Union St. SE
Minneapolis, MN 55455-0160

D. H. Huang
Aono Atomcraft Project
Exploratory Research for Advanced
Technology
Japan Research Development Corp.
Tokodai 5-9-9
Tsukuba, Ibaraki 300-26, Japan

H. J. Hug
Univ. of Basel
Institute of Physics
Klingelbergstrasse 82
CH-4056 Basel, Switzerland

T. A. Jung
Univ. of Basel
Institute of Physics
Klingelbergstrasse 82
CH-4056 Basel, Switzerland

Dieter P. Kern
IBM Thomas J. Watson Research Ctr.
MS 17-207
P.O. Box 218
Yorktown Heights, NY 10598-0218, USA

A. Kobayashi
Aono Atomcraft Project
Exploratory Research for Advanced
Technology
Japan Research Development Corp.
Tokodai 5-9-9
Tsukuba, Ibaraki 300-26, Japan

G. P. Kochanski
AT&T Bell Labs.
Murray Hill, NJ 07974, USA

Charles Lieber
Harvard Univ.
Applied Sciences
Dept. of Chemistry
Cambridge, MA 02138, USA

Stuart M. Lindsay
Arizona State Univ.
Dept. of Physics
Tempe, AZ 85287-0001, USA

Joseph W. Lyding
Univ. of Illinois
Dept. of Electrical and Computer
Engineering
Urbana, IL 61801, USA

Arun Majumdar
Univ. of California/Santa Barbara
Dept. of Mechanical & Environmental
Engineering
Santa Barbara, CA 93106-5070, USA

Herschel M. Marchman
AT&T Bell Labs.
Rm. 7E-411
600 Mountain Ave.
Murray Hill, NJ 07974-2008, USA

Christie R. K. Marrian
Naval Research Lab.
Electronics Science & Technology Div.
Code 6864
4555 Overlook Dr.
Washington, DC 20375-5347, USA

Sterling E. McBride
Univ. of Texas/ Dallas
Erik Jonsson School of Engineering and
Computer Sciences
MP 33
P.O. Box 830688
Richardson, TX 75083-0688, USA

M. A. McCord
IBM Corp.
Semiconductor Research and
Development Ctr.
P.O. Box 218
Yorktown Heights, NY 10598, USA

A. Moser
Univ. of Basel
Institute of Physics
Klingelbergstrasse 82
CH-4056 Basel, Switzerland

L. P. Muray
Cornell Univ.
Knight Lab.
National Nanofabrication Facility
Ithaca, NY 14853, USA

Munir Nayfeh
Univ. of Illinois/Urbana-Champaign
Dept. of Physics
1110 W. Green St.
Urbana, IL 61801, USA

R. F. W. Pease
Stanford Univ.
Solid State Electronics Lab.
MC 4055, Electrical Engineering Dept.
McCullough 204
Stanford, CA 94305-4055, USA

John N. Randall
Texas Instruments Inc.
Central Research Labs.
MS 134
13588 N. Central Expressway
Dallas, TX 75243-1108, USA

Phillip E. Russell
North Carolina State Univ.
Materials Science Dept.
P.O. Box 7916
Raleigh, NC 27695-0001, USA

Jason Schneir
National Institute of Standards and
Technology
Building 220, Room A107
Gaithersburg, MD 20899-0001, USA

U. D. Schwarz
Univ. of Hamburg
Institute of Applied Physics
Jurginsstrasse 11
20355 Hamburg, Germany

W. F. Smith
Univ. of Texas/Austin
Physics Dept.
Austin, TX 78712-1020, USA

U. Stauffer
Univ. of Basel
Institute of Physics
Klingelbergstr. 82
CH-4056 Basel, Switzerland

E. C. Teague
National Institute of Standards and
Technology
Precision Engineering Div.
Building 220, Room A117
Gaithersburg, MD 20899, USA

John R. Tucker
Univ. of Illinois
Dept. of Electrical and Computer
Engineering
Urbana, IL 61801, USA

H. Uchida
Aono Atomcraft Project
Exploratory Research for Advanced
Technology
Japan Research Development Corp.
Tokodai 5-9-9
Tsukuba, Ibaraki 300-26, Japan

Michael J. Vasile
AT&T Bell Labs.
MS 2C-105
600 Mountain Avenue
New Providence, NJ 07974-2008, USA

Grover C. Wetsel
Univ. of Texas/Dallas
Erik Jonsson School of Engineering and
Computer Sciences
MP 33
P.O. Box 830688
Richardson, TX 75083-0688, USA

Roland Wiesendanger
Univ. of Basel
Dept. of Physics
Klingelbergstrasse 82
CH-4056 Basel, Switzerland