Ion Beams — New Applications from Mesoscale to Nanoscale

https://doi.org/10.1557/opl.2011.1488 Published online by Cambridge University Press

MATERIALS RESEARCH SOCIETY
SYMPOSIUM PROCEEDINGS VOLUME 1354

Ion Beams — New Applications from Mesoscale to Nanoscale

Symposium held April 25–29, 2011, San Francisco, California, U.S.A.

EDITORS

John Baglin
IBM Almaden Research Center
San Jose, California, U.S.A.

Daryush ILA
Fayetteville State University
Fayetteville, North Carolina, U.S.A.

Giovanni Marletta
Universita degli Studi di Catania
Catania, Italy

Ahmet Öztarhan
Ege University
Izmir, Turkey

Materials Research Society
Warrendale, Pennsylvania

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town,
Singapore, São Paulo, Delhi, Tokyo, Mexico City

Cambridge University Press
32 Avenue of the Americas, New York, NY 10013-2473, USA

www.cambridge.org
Information on this title: www.cambridge.org/9781605113319

Materials Research Society
506 Keystone Drive, Warrendale, PA 15086, USA
http://www.mrs.org

First published 2012

CODEN: MRSPDH

ISBN: 978-1-60511-331-9 Hardback

CONTENTS

https://doi.org/10.1557/opl.2011.1488 Published online by Cambridge University Press

*Invited Paper

https://doi.org/10.1557/opl.2011.1488 Published online by Cambridge University Press

FORUM REPORT

https://doi.org/10.1557/opl.2011.1488 Published online by Cambridge University Press

PREFACE

Symposium II, "Ion Beams — New Applications from Mesoscale to Nanoscale" was held at the 2011 MRS Spring Meeting, April 25-29, 2011 in San Francisco, California.

This symposium welcomed presentations on ion-beam engineering and characterization of materials properties, structure, topography, or functionality, spanning dimensions from the mesoscale to the nanoscale. Indeed, while the unique capabilities of ion-beam techniques in the diverse emerging fields of nanoscience and nanotechnology are fast becoming critical for many new applications, the flexibility of ion-beam techniques now enables the development of new tools that can integrate tailoring of nanoscale patterns and structures with unique in-situ imaging and analysis – as indicated by the wealth of research reports presented in this volume. The recent evolution of such instrumentation has energized new programs, both basic and applied, in fast-developing areas ranging over advanced semiconductor integration, information storage, sensors, plasmonics, molecular engineering, biomaterials, and many aspects of the development of alternative energy resources.

In a field displaying such rapid evolution on many fronts, it is appropriate for us to pause occasionally and review the overall state of the field, and its emerging opportunities and challenges. Two special Forum sessions, late in the Symposium, (titled "Ion Beam Institute"), were held to facilitate such consideration. They yielded lively discussion and remarkable consensus of opinion about the direction and priorities of the field for the future. These sessions are summarized in detail in the concluding paper of this volume. That report displays a dynamic state of the field, especially with respect to interdisciplinary applications, and notably for the bio sciences, where ion beam techniques have much to offer in new emerging basic research and applications.

The organizers would like to take this opportunity to thank the sponsors of this Symposium, (NASA and National Electrostatics Corporation) for their generous financial support.

John Baglin
Daryush ILA
Giovanni Marletta
Ahmet Öztarhan

September 2011

Materials Research Society Symposium Proceedings

Volume 1321 — Amorphous and Polycrystalline Thin-Film Silicon Science and Technology—2011, B. Yan, Q. Wang, H. Gleskova, C.C. Tsai, S. Higashi, 2011, ISBN 978-1-60511-298-5
Volume 1322 — Third-Generation and Emerging Solar-Cell Technologies, Y. Lu, J.M. Merrill, M.T. Lusk, S. Bailey, A. Franceschetti, 2011, ISBN 978-1-60511-299-2
Volume 1323 — Advanced Materials Processing for Scalable Solar-Cell Manufacturing, H. Ji, B. Ren, L. Tsakalakos, 2011, ISBN 978-1-60511-300-5
Volume 1324 — Compound Semiconductors for Energy Applications and Environmental Sustainability—2011, F. Shahedipour-Sandvik, L.D. Bell, K. Jones, B. Simpkins, D. Schaadt, M. Contreras, 2011, ISBN 978-1-60511-301-2
Volume 1325 — Energy Harvesting—Recent Advances in Materials, Devices and Applications, R. Venkatasubramanian, H. Liang, H. Radousky, J. Poon, 2011, ISBN 978-1-60511-302-9
Volume 1326E — Renewable Fuels and Nanotechnology, H. Idriss, 2011, ISBN 978-1-60511-303-6
Volume 1327 — Complex Oxide Materials for Emerging Energy Technologies, J.D. Perkins, A. Ohtomo, H.N. Lee, G. Herranz, 2011, ISBN 978-1-60511-304-3
Volume 1328E — Electrochromic Materials and Devices, M. Bendikov, D. Gillaspie, T. Richardson, 2011, ISBN 978-1-60511-305-0
Volume 1329E — Nanoscale Heat Transfer—Thermoelectrics, Thermophotovoltaics and Emerging Thermal Devices, K. Nielsch, S.F. Fischer, B.J.H. Stadler, T. Kamins, 2011, ISBN 978-1-60511-306-7
Volume 1330E — Protons in Solids, V. Peterson, 2011, ISBN 978-1-60511-307-4
Volume 1331E — Frontiers of Solid-State Ionics, K. Kita, 2011, ISBN 978-1-60511-308-1
Volume 1332E — Interfacial Phenomena and *In-Situ* Techniques for Electrochemical Energy Storage and Conversion, H. Li, 2011, ISBN 978-1-60511-309-8
Volume 1333E — Nanostructured Materials for Energy Storage, J. Lemmon, 2011, ISBN 978-1-60511-310-4
Volume 1334E — Recent Developments in Materials for Hydrogen Storage and Carbon-Capture Technologies, R. Zidan, 2011, ISBN 978-1-60511-311-1
Volume 1335 — Materials, Processes, and Reliability for Advanced Interconnects for Micro- and Nanoelectronics—2011, M. Baklanov, G. Dubois, C. Dussarrat, T. Kokubo, S. Ogawa, 2011, ISBN 978-1-60511-312-8
Volume 1336E — Interface Engineering for Post-CMOS Emerging Channel Materials, Y. Kamata, 2011, ISBN 978-1-60511-313-5
Volume 1337 — New Functional Materials and Emerging Device Architectures for Nonvolatile Memories, D. Wouters, O. Auciello, P. Dimitrakis, Y. Fujisaki, E. Tokumitsu, 2011, ISBN 978-1-60511-314-2
Volume 1338E — Phase-Change Materials for Memory and Reconfigurable Electronics Applications, B.-K. Cheong, P. Fons, B.J. Kooi, B.-S. Lee, R. Zhao, 2011, ISBN 978-1-60511-315-9
Volume 1339E — Plasma-Assisted Materials Processing and Synthesis, J.L. Endrino, A. Anders, J. Andersson, D. Horwat, M. Vinnichenko, 2011, ISBN 978-1-60511-316-6
Volume 1340E — High-Speed and Large-Area Printing of Micro/Nanostructures and Devices, T. Sekitani, 2011, ISBN 978-1-60511-317-3
Volume 1341 — Nuclear Radiation Detection Materials—2011, A. Burger, M. Fiederle, L. Franks, K. Lynn, D.L. Perry, K. Yasuda, 2011, ISBN 978-1-60511-318-0
Volume 1342 — Rare-Earth Doping of Advanced Materials for Photonic Applications—2011, V. Dierolf, Y. Fujiwara, T. Gregorkiewicz, W.M. Jadwisienczak, 2011, ISBN 978-1-60511-319-7
Volume 1343E — Recent Progress in Metamaterials and Plasmonics, G.J. Brown, J. Pendry, D. Smith, Y. Lu, N.X. Fang, 2011, ISBN 978-1-60511-320-3
Volume 1344 — Functional Two-Dimensional Layered Materials—From Graphene to Topological Insulators, A.A. Balandin, A. Geim, J. Huang, D. Li, 2011, ISBN 978-1-60511-321-0
Volume 1345E — Nanoscale Electromechanics of Inorganic, Macromolecular and Biological Systems, J. Li, S.V. Kalinin, M.-F. Yu, P.S. Weiss, 2011, ISBN 978-1-60511-322-7
Volume 1346 — Micro- and Nanofluidic Systems for Materials Synthesis, Device Assembly and Bioanalysis—2011, R. Fan, J. Fu, J. Qin, A. Radenovic, 2011, ISBN 978-1-60511-323-4
Volume 1347E — Nanoscale Heat Transport—From Fundamentals to Devices, A. McGaughey, M. Su, S. Putnam, J. Shiomi, 2011, ISBN 978-1-60511-324-1

MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS

Volume 1348E — Hybrid Interfaces and Devices, D.S. Ginley, N.R. Armstrong, G. Frey, R.T. Collins, 2011, ISBN 978-1-60511-325-8
Volume 1349E — Quantitative Characterization of Nanostructured Materials, A. Kirkland, 2011, ISBN 978-1-60511-326-5
Volume 1350E — Semiconductor Nanowires—From Fundamentals to Applications, V. Schmidt, L.J. Lauhon, T. Fukui, G.T. Wang, M. Björk, 2011, ISBN 978-1-60511-327-2
Volume 1351 — Surfaces and Nanomaterials for Catalysis through *In-Situ* or *Ex-Situ* Studies, F. Tao, M. Salmeron, J.A. Rodriguez, J. Hu, 2011, ISBN 978-1-60511-328-9
Volume 1352 — Titanium Dioxide Nanomaterials, X. Chen, M. Graetzel, C. Li, P.D. Cozzoli, 2011, ISBN 978-1-60511-329-6
Volume 1353E — The Business of Nanotechnology III, L. Merhari, M. Biberger, D. Cruikshank, M. Theelen, 2011, ISBN 978-1-60511-330-2
Volume 1354 — Ion Beams—New Applications from Mesoscale to Nanoscale, J. Baglin, D. Ila, G. Marletta, A. Öztarhan, 2011, ISBN 978-1-60511-331-9
Volume 1355E — Biological Hybrid Materials for Life Sciences, L. Stanciu, S. Andreescu, T. Noguer, B. Liu, 2011, ISBN 978-1-60511-332-6
Volume 1356E — Microbial Life on Surfaces—Biofilm-Material Interactions, N. Abu-Lail, W. Goodson, B.H. Lower, M. Fornalik, R. Lins, 2011, ISBN 978-1-60511-333-3
Volume 1357E — Biomimetic Engineering of Micro- and Nanoparticles, D. Discher, 2011, ISBN 978-1-60511-334-0
Volume 1358E — Organic Bioelectronics and Photonics for Sensing and Regulation, L. Torsi, 2011, ISBN 978-1-60511-335-7
Volume 1359 — Electronic Organic and Inorganic Hybrid Nanomaterials—Synthesis, Device Physics and Their Applications, Z.-L. Zhou, C. Sanchez, M. Popall, J. Pei, 2011, ISBN 978-1-60511-336-4
Volume 1360 — Synthesis and Processing of Organic and Polymeric Materials for Semiconductor Applications, A.B. Padmaperuma, J. Li, C.-C. Wu, J.-B. Xu, N.S. Radu, 2011, ISBN 978-1-60511-337-1
Volume 1361E — Engineering Polymers for Stem-Cell-Fate Regulation and Regenerative Medicine, S. Heilshorn, J.C. Liu, S. Lyu, W. Shen, 2011, ISBN 978-1-60511-338-8
Volume 1362 — Carbon Functional Interfaces, J.A. Garrido, K. Haenen, D. Ho, K.P. Loh, 2011, ISBN 978-1-60511-339-5
Volume 1363 — Fundamental Science of Defects and Microstructure in Advanced Materials for Energy, B.P. Uberuaga, A. El-Azab, G.M. Stocks, 2011, ISBN 978-1-60511-340-1
Volume 1364E — Forum on Materials Education and Evaluation—K-12, Undergraduate, Graduate and Informal, B.M. Olds, D. Steinberg, A. Risbud, 2011, ISBN 978-1-60511-341-8
Volume 1365 — Laser-Material Interactions at Micro/Nanoscales, Y. Lu, C.B. Arnold, C.P. Grigoropoulos, M. Stuke, S.M. Yalisove, 2011, ISBN 978-1-60511-342-5
Volume 1366E — Crystalline Nanoporous Framework Materials—Applications and Technological Feasibility, M.D. Allendorf, K. McCoy, A.A. Talin, S. Kaskel, 2011, ISBN 978-1-60511-343-2
Volume 1367E — Future Directions in High-Temperature Superconductivity—New Materials and Applications, C. Cantoni, A. Ballarino, K. Matsumoto, V. Solovyov, H. Wang, 2011, ISBN 978-1-60511-344-9
Volume 1368 — Multiferroic, Ferroelectric, and Functional Materials, Interfaces and Heterostructures, P. Paruch, E. Tsymbal, M. Rzchowski, T. Tybell, 2011, ISBN 978-1-60511-345-6
Volume 1369E — Computational Studies of Phase Stability and Microstructure Evolution, Z.-K. Liu, 2011, ISBN 978-1-60511-346-3
Volume 1370 — Computational Semiconductor Materials Science, L. Liu, S.-H. Wei, A. Rubio, H. Guo, 2011, ISBN 978-1-60511-347-0

Prior Materials Research Society Symposium Proceedings available by contacting Materials Research Society