Nanowires—Synthesis, Properties, Assembly and Applications
Nanowires—Synthesis, Properties, Assembly and Applications

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EDITORS:

Yi Cui
Stanford University
Stanford, California, U.S.A.

Lincoln Lauhon
Northwestern University
Evanston, Illinois, U.S.A.

A. Alec Talin
Sandia National Laboratories
Livermore, California, U.S.A.

E.P.A.M. Bakkers
Philips Research Laboratories
Eindhoven, Netherlands
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CONTENTS

Preface ......................................................................................................................... ix

Materials Research Society Symposium Proceedings ................................................... xi

Growth of Ultra Thin ZnSe Nanowires ................................................................. 1
   Tai Lun Wong, Yuan Cai, Siu Keung Chan,
   Lam Keong Sou, and Ning Wang

Optical Properties of Single Wurtzite GaAs Nanowires and
GaAs Nanowires with GaAsSb Inserts ................................................................. 7
   Thang B. Hoang, Hailong Zhou, Anthonysamy Moses,
   Dasa Dheeraj, Antonius van Helvoort, Bjorn-Ove Fimland,
   and Helge Weman

Epitaxial Growth of Si Nanowires by a Modified VLS
Method Using Molten Ga as Growth Assistant .................................................. 13
   Annika Gewalt, Bodo Kalkofen, Marco Lisker,
   and Edmund P. Burte

Matrix Formation Leading to Catalyst Free Growth of
GaN Nanowires ....................................................................................................... 19
   Joshua Halpern, Gary L. Harris, Maoqi He,
   Piezhen Zhou, and Christina E. Cheek

Annealing of Nanocrystalline Silicon Micro-Bridges with
Electrical Stress ..................................................................................................... 25
   Gokhan Bakan, Adam Cywar, Cicek Boztug,
   Mustafa B. Akbulut, Helena Silva, and Ali Gokirmak

Three-Dimensional Structure of Helical and Zigzagged
Nanowires Using Electron Tomography ............................................................ 31
   Han Sung Kim, Yoon Myung, Chang Hyun Kim,
   Seung Yong Bae, Jae-Young Ahn, and Jeunghee Park

Anodization of NbN .................................................................................................. 39
   Travis L. Wade, Damien Lucot, Abdullah A. Ahmari,
   Mihaela-Cristina Ciornei, Jean-Eric Wegrowe, and
   Kees van der Beek
Langmuir-Blodgett Films of One-Dimensional Nanowires Composed of Amphiphilic Tetrathiafulvalenes and Electron Acceptor ................................................................. 45
  Yoko Tatewaki, Junko Takizawa, Tatsuya Hatanaka,
  Mutsumi Kimura, and Hirofusa Shirai

Structural and Electronic Properties of Rare-Earth Nanowires ................................................................................................................................. 51
  Andrew Pratt, Charles Woffinden,
  Christopher Bonet, and Steve P. Tear

Effect of Metal-Silicon Nanowire Contacts on the Performance of Accumulation Metal Oxide Semiconductor Field Effect Transistor ................................................................. 57
  Pranav Garg, Yi Hong, Md Mash-Hud Iqbal,
  and Stephen J. Fonash

High Performance Printed Aligned Carbon Nanotube Transistors on Both Rigid and Flexible Substrates for Transparent Electronics ................................................................................ 63
  Hsiao-Kang Chang, Fumiaki Ishikawa,
  Koungmin Ryu, Pochiang Chen,
  Alexander Badmaev, Guozhen Shen,
  and Chongwu Zhou

Hydrothermal Synthesis and Photocatalytic Activity of Titanium Dioxide Nanotubes, Nanowires and Nanospheres ................................................................. 71
  Jin Wang, Ming Li, Mingjia Zhi,
  Ayyakkannu Manivannan, and
  Nianqiang Wu

Enhanced 1540 nm Emission from Er-doped ZnO Nanorod Arrays via Coupling with Localized Surface Plasmon of Au Island Film ................................................................................ 77
  Jiang-Wei Lo, Chin-An Lin, and Jr-Hau He

Effects of Laser Ablation on Growth of ZnO/ZnS/ZnO Multilayer Structured Nanorods by Chemical Vapor Deposition ................................................................................ 85
  Takashi Hirate, Hiroaki Koisikawa,
  Makoto Yugi, Takuya Kumada,
  Yuki Matsuzawa, and Tomomasa Satoh
Growth and Characterization of p-n Junction Core-Shell GaAs Nanowires on Carbon Nanotube Composite Films
Parsian Mohseni, Gregor Lawson, Alex Adronov, and Ray LaPierre

Luminescence Characterization of InGaN/GaN Vertical Heterostructures Grown on GaN Nanocolumns
Rob Armitage

Near-Infrared Lasers in GaAs/GaAsP Coaxial Core-Shell Nanowires
Bin Hua, Junichi Motohisa, Shinjiroh Hara, and Takashi Fukui

Fabrication of ZnO Bridging Nanowire Device by a Single-Step Chemical Vapor Deposition Method
Yanbo Li, Ippei Nagatomo, Ryohei Uchino, Ichiro Yamada, and Jean-Jacques Delaunay

Modeling of the Oxidation of Suspended Silicon Nanowires
Pier-Francesco Fazzini, Caroline Bonafos, Alexandre Hubert, Jean-Pierre Colonna, Thomas Ernst, Marc Respaud, and Florence Gloux

Nanorods as a Precursor for High Quality GaN Layers
David Cherns, Ian Griffiths, Somboon Khongphetsak, Sergey V. Novikov, Richard Campion, Nicola Farley, and Tom Foxon

Stabilizing Dispersions of Large Quantities of Selenium Nanowires
Michael C. Wang and Byron D. Gates

Grafting of Organic Molecules on Silicon Nanowires
Kaoru Kajiwara, Masato Ara, and Hirokazu Tada

Electronic Structure and Magnetization of Diluted Magnetic Semiconductor Nanowires
Yong Jae Cho, Kyung Hwan Ji, Chang Hyun Kim, Han Sung Kim, Yong Jei Son, and Jeunghee Park
ZnO/Al₂O₃ Core-Shell Nanorod Arrays: Processing, Structural Characterization, and Luminescent Property ........................................151
Cheng-Ying Chen, Chin-An Lin, Miin-Jang Chen, Gong-Ru Lin, and Jr-Hau He

Structural and Optical Properties of Pseudobinary Wurtzite Alloy Nanowires.............................................................................161
S. Joon Kwon, Jae-Gwan Park, Young-Jin Choi, Kyoung-Jin Choi, and Dong-Wan Kim

Novel Inorganic DC Lateral Thin Film Electroluminescent Devices Composed of ZnO Nanorods and ZnS Phosphor ..........................167
Tomomasa Satoh, Yuki Matsuzawa, Hiroaki Koishikawa, and Takashi Hirate

Directed Assembly of Nanowires Using Silicon Grooves and Localized Surface Treatments.........................................................173
Sabrina Habtoun, Christian Bergaud, Monique Dilhan, and David Bourrier

Silver Nanowires: Synthesis, Characterization and Optical Properties .......................................................................................179
Yuri A. Barnakov, Heng Li, Guohua Zhu, Mohammed Mayy, Erik J. Robinson, Carl Bonner, and M. Noginov

The Strength of Gold Nanowires and Nanoporous Gold .................................................185
Rui Dou and Brian Derby

Electrofluidic Positioning of Biofunctionalized Nanowires .............................................191
Thomas J. Morrow, Jaekyun Kim, Mingwei Li, Theresa S. Mayer, and Christine D. Keating

Author Index ..................................................................................................................197

Subject Index ..................................................................................................................199
PREFACE

One-dimensional nanowires support the transport of charge carriers, photons and ions along their length while maintaining nanoscale effects across their diameter. The unique nanowires from versatile materials have shown great promise in nanoscale electronics, photonics, thermoelectrics, biotechnology, and energy conversion. Symposium LL, “Nanowires—Synthesis, Properties, Assembly and Applications,” held December 1–5 at the 2008 MRS Fall Meeting, in Boston, Massachusetts, has provided the opportunity for discussing the critical issues related to nanowires and recent progresses in synthesis, structure, properties and devices. Specific topics of the symposium covered:

1) Synthesis with control over composition, size, shape, position, geometry, doping, alloying and heterostructures. Materials include Group IV, III-V, II-VI, metal and metal oxide and chalcogenide materials.

2) Properties: mechanical, electronic, optical, thermal, magnetic, ionic, phase transformational, chemical properties, etc.

3) Assembly and integration: methods for organizing nanowires, multiple length scale pattern formation, heterogeneous integration, assembly architecture, etc.

4) Applications: functional devices and systems for electronics, photonics, sensors, renewable energy.

The symposium consisted of 98 oral presentations, of which 14 were invited, and 142 poster presentations. The presentations were grouped into topical sessions, which covered growth mechanisms, doping, memory and logic applications, emerging applications, optical and magnetic properties, electromechanical properties, electrical and thermal transport, sensing, heterostructure synthesis, photodetection, and the synthesis and properties of metallic nanowires.

By all accounts, our symposium has been an astounding success. We received a total of 272 abstracts, second only to Symposium JJ, which also included the subject of nanowires. Due to the large number of submissions, Symposium LL included oral sessions throughout the entire 5 days of the conference, as well as 3 poster nights. Session attendance was consistently high, including several presentations with standing room only.

Many outstanding talks and posters were presented at the symposium. The presentations that particularly stand out include the invited lecture by Prof. Charles Lieber, in which he traced the developments in nanowires, highlighting the various fundamental scientific and technologically significant discoveries, such as chem/bio sensing, nanoscale light sources, quantum electronics, etc. that have been enabled by semiconductor nanowires. Another paper worth mentioning was by Naoki Fukata et al., from National Institute for Materials Sciences, Tsukuba, Japan, titled “Phosphorus Donors and Boron Acceptors in Silicon Nanowires Synthesized by Laser Ablation.” Fukata used a combination of Raman scattering and ESR measurements to show how
P and B dopant incorporate and preferentially segregate in Si nanowires. Dopant control is key to making functional nanowire devices, and the poster by Fukata et al. received the MRS poster award. Another outstanding paper was presented by Irene Goldthorpe, from Stanford, titled "Synthesis and Strain Relaxation Mechanisms of Ge-core/Si-shell Nanowires." The paper, which won the graduate student award silver medal, discussed in detail the strain relief mechanisms in Ge/Si core shell nanowires. Another noteworthy paper which also won the silver medal was presented by Y. Jung, from Materials Science and Engineering, University of Pennsylvania, titled "Phase-Change Nanowires: Size-dependent Electronic Memory Switching and Core/shell Heterostructured Multi-state Memory." Jung et al. reported on two classes of phase change nanowires based on the GST materials system and their memory switching characteristics, and related that these nanowires satisfy many of the technological requirements for successful device implementation.

Semiconductor nanowires are rich in fundamental issues and promise revolutionary new device concepts. Devices fabricated from these nanoscale structures may offer significantly improved photonic and electronic performance. Given the interest, fascination, and rapid development in the field of nanowires, this topic should continue to figure prominently among MRS symposia. Many fundamental issues concerning nanowire growth mechanisms, dopant incorporation, heterostructures, role of surface states, contact formation, and integration into functional devices remain unclear and will undoubtedly generate interest in the scientific community. Equally important are the new opportunities associated with advances in nanowire science and technology, such as applications of these materials in energy harvesting and conversion, chemical and biological sensing, and novel memory and logic devices.

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Yi Cui
Lincoln Lauhon
A. Alec Talin
E.P.A.M. Bakkers

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