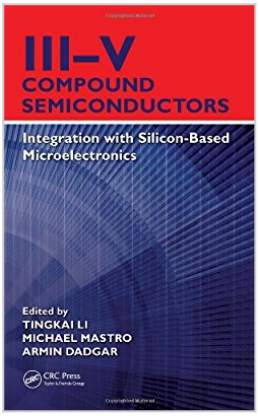

III–V Compound Semiconductors: Integration with Silicon-Based Microelectronics

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Silicon-based microelectronics has steadily improved in various performance-to-cost metrics. But after decades of processor scaling, fundamental limitations and considerable new challenges have emerged. The integration of compound semiconductors is the leading candidate to address many of these issues and to continue the relentless pursuit of more powerful, cost-effective processors.

III-V Compound Semiconductors: Integration with Silicon-Based Microelectronics covers recent progress in this area, addressing the two major revolutions occurring in the semiconductor industry: integration of compound semiconductors into Si microelectronics, and their fabrication on large-area Si substrates. The authors present a scientific and technological exploration of GaN, GaAs, and III-V compound semiconductor devices within Si microelectronics, building a fundamental foundation to help readers deal with relevant design and application issues.

Explores silicon-based CMOS applications developed within the cutting-edge DARPA program

Providing an overview of systems, devices, and their component materials, this book:

- Describes structure, phase diagrams, and physical and chemical properties of III-V and Si materials, as well as integration challenges
- Focuses on the key merits of GaN, including its importance in commercializing a new class of power diodes and transistors
- Analyzes more traditional III-V materials, discussing their merits and drawbacks for device integration with Si microelectronics
- Elucidates properties of III-V semiconductors and describes approaches to evaluate and characterize their attributes

- Introduces novel technologies for the measurement and evaluation of material quality and device properties
- Investigates state-of-the-art optical devices, LEDs, Si photonics, high-speed, high-power III-V materials and devices, III-V solar cell devices, and more

Assembling the work of renowned experts, this is a reference for scientists and engineers working at the intersection of Si and compound semiconductor technology. Its comprehensive coverage is valuable for both students and experts in this burgeoning field.

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III–V Compound Semiconductors: Integration with Silicon-Based Microelectronics From Brand: CRC Press Bibliography

- Sales Rank: #3739441 in Books
- Brand: Brand: CRC Press
- Published on: 2010-12-02
- Original language: English
- Number of items: 1
- Dimensions: 9.10" h x 1.30" w x 6.10" l, .0 pounds
- Binding: Hardcover
- 603 pages

Editorial Review

About the Author

Tingkai Li, Ph.D., is currently working at Micron Technology, Inc. as a senior technical member. He published over 100 technical papers, edited three preceding books, and was granted 93 US patents and many awards related in semiconductor and compound semiconductor device and materials research. He is an invited paper reviewer of the Applied Physics Letter, Journal of Applied Physics, IEEE Electron Device Letter, IEEE Transaction of Electron Device, etc., and overseas editor of Journal of Inorganic Materials. He is also honorary professor at Hunan University, Wuhan University of Technologies, and Zhejiang University in China. Dr. Li received a Ph.D. degree in Materials Science and Engineering from Zhejiang University, P. R. China, in 1987, and was a postdoctoral fellow and research scientist at Virginia Polytechnic Institute and State University, Blacksburg, Virginia from 1989-1995. From 1995-1998, he worked as a Staff Scientist in EMCORE Cooperation, New Jersey. He joined Sharp Laboratories in 1998 as a principal member of technical staff and project manager.

Michael Mastro, currently a civilian staff scientist at the U.S. Naval Research Lab, has more than 10 years of research experience in thin film growth and characterization, as well as semiconductor device design and nano-fabrication. This includes a number of fundamental advances in the fabrication of planar LEDs and high-power electronic devices, in addition to the development of novel nano-devices, which has resulted in authorship on more than 100 papers and patents. Michael earned a Ph.D. from the University of Florida in 2001 and a B.S. in Chemical Engineering from the Johns Hopkins University in 1997.

Armin Dadgar studied physics at University of Heidelberg and at TU-Berlin, where he received his doctor of natural sciences in 1999, successfully developing an alternative method to Fe doping to obtain semiinsulating InP by using Ru. Since 1999 has worked at the Otto-von-Guericke-Universitaet Magdeburg in the group of Prof. Alois Krost and is private lecturer since 2005. There he developed methods to grow thick crack-free GaN on Si by MOVPE in 2000 and demonstrated the first thick crack-free GaN LED grown by a patterning method in 2001 followed by the first thick crack-free LED on planar silicon substrate shortly after. In 2003 he co-founded AZZURRO Semiconductors AG and held the CTO position until he left the company in 2009. During his time at AZZURRO he demonstrated the first GaN-on-Silicon on 150 mm substrates in 2005, high voltage GaN on Si FETs up to 1800 V breakdown voltage and successfully transferred an LED buffer growth process to OSRAM Opto Semiconductors in 2008/2009. He is author of more than 150 papers, co-inventor of more than 30 patents or patent applications in the field of semiconductors, and received several national awards for his pioneering work on GaN-on-Silicon.

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