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Materials Research society Symposium proceedings: volume 1068

Editors: Tingkai Li, Joan M. Redwing, Michael Mastro, Edwin L. Piner and Armin Dadgar  
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**MATERIALS RESEARCH SOCIETY  
SYMPOSIUM PROCEEDINGS VOLUME 1068**

# **Advances in GaN, GaAs, SiC and Related Alloys on Silicon Substrates**

Symposium held March 24–28, 2008, San Francisco, California, U.S.A.

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## PREFACE

Symposium C, "Advances in GaN, GaAs, SiC and Related Alloys on Silicon Substrates," was held March 24–28 at the 2008 MRS Spring Meeting in San Francisco, California. To meet increasingly challenging and complex system requirements as well as staying cost effective, it is not enough to use one single semiconductor materials system. Therefore, major efforts have been expended in recent years to combine the low cost and well established Si-based CMOS processing attributes with the superior performance attributes of Compound Semiconductors (CS). Such a combination—marrying the best of both worlds—will enable performance superior to that achievable with CS and CMOS alone with CMOS affordability. With an approach that directly integrates the CS into the CMOS wafer, only one wafer is processed to achieve a finished chip. Therefore, great efforts have been made to achieve direct integration of III-V materials systems such as GaN, GaAs, SiC and related alloys with Si. Many different approaches have been developed to overcome major lattice and thermal expansion mismatches between these systems with great success as illustrated by the multitude of excellent work presented, and the fact that excellent device performance has been achieved and are starting to become commercially available.

The *GaN Based Electronic Device and Sensors on Silicon* chapter gives an overview of the exciting new high power GaN-on-Si high electron mobility transistor (HEMT) devices, field effect transistor (FET) devices and sensors, and also reported on the new results on crack-free AlGaIn/GaN HEMT devices grown on 6" Si substrates with low sheet resistance. The high efficiency GaN base light emission diode (LED), rare earth co-doping LEDs, and other optical devices on silicon are discussed in the *GaN Based Optical Devices on Silicon* chapter. The *GaN and Related Alloys on Silicon Growth and Integration Techniques* chapter focuses on materials challenges one faces when trying to grow GaN and Related Alloys respectively onto Si substrates due to lattice mismatch and the relative large thermal expansion mismatches. Discussed are various approaches taken to overcome those challenges and how they affect electrical and optical properties, followed by device performance. The chapter also presents very promising results on H-MOVPE growth of thick crack-free GaN on nanopatterned Si substrates, and InGaIn thin film growth on Si(111) by the newly developed ENABLE technique (Energetic Neutral Atomic-Beam Lithography and Epitaxy) for electronic and optoelectronic devices, including solar cells. The *Conventional III-V Materials and Devices on Silicon* chapter describes a wide variety of III-V materials integrated on silicon, as well as high speed III-V devices introducing HEMTs, modulation doping and quantum well structures. The devices evolved from GaAs-based to InP-based HEMTs and HBTs, leading to next generation Sb based devices. In turn, various concepts were introduced, and examples were discussed, including fabrication processes and the challenges of producing good ohmic contacts due to the doping limitations in GaAs. The chapter also presents the growth of semiconductor nanowires as a route to combining heavily mismatched materials with focus on the growth of III-V nanowires on group IV substrates. The *Silicon and Other Materials on Silicon* chapter includes the current states of SiC and other materials integrated on silicon for electronics and optical devices applications.

The strong and increasing interest in GaN, GaAs, SiC and related alloys on silicon substrates indicates the worldwide importance of these materials and devices. This symposium proceedings represents the latest technical advancements and information on III-V materials and devices on silicon substrates from universities, national laboratories and industries. It also provides insight into emerging trends in these exciting technologies.

Tingkai Li  
Joan M. Redwing  
Michael Mastro  
Edwin L. Piner  
Armin Dadgar

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Ulrich Heinle	Takashi Egawa
Edward Y. Chang	Mark Fanton
Olga Kryliouk	

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