Preface

The GaN materials system has applications in visible and UV light emitting devices and in high power, high temperature electronics. On the photonics side, the AlGaInN materials system, consisting of AlGaN/GaN, InAlN/GaN, and InGaN/GaN heterostructures and the GaN, AlN, and InN binaries, is widely used in blue/violet/white/UV light emitting diodes for stoplights and full color displays, blue and green lasers for use in high-density CD-ROM storage and high-resolution printers. The main applications for GaN-based high power microwave transistors are in phased array radar systems and wireless communication systems, while the low noise, radiation hard transistors can be used in high temperature sensors and spaceflight instrumentation. There have been many recent advances in this field, concerning sensors and nanostructure synthesis. Functional nanostructures are attracting much interest for use in sensing, energy harvesting and cell monitoring. In addition, there is a widespread interest in the use of ZnO in UV light emitters and flexible electronics. Flexible displays are attractive for portable devices such as smart phones, laptops, e-books, and wearable devices due to their lightweight, low power consumption, and being bendable. In defense applications, soldiers can use flexible display computers on the battlefield for communication and information access. Thin-film transistors (TFTs) are field effect transistors made by depositing thin films of amorphous Si, organics, or new inorganics based on ZnO for the semiconductor active layer. The channel region of a TFT is deposited onto a substrate such as glass, since the main market is in liquid crystal displays (LCDs). Since these types of substrates do not allow for high temperature processing, the TFT active region must be deposited at low temperature. Recently, indium zinc oxides (IZO) such as 90 wt% In_2O_3–10 wt% ZnO and homogeneous $In_2O_3(ZnO)_k$ ($k = 2, 3, 4, 5, 6, 7, 9, 11, 13,$ and 15) compounds have attracted significant attention as new candidates for transparent electrodes due to their good conductivity, high optical transparency, excellent surface smoothness, and low deposition temperature. One of the major challenges in the development of transparent thin-film transistors is to control the carrier concentration with high transparency in the active channel. For active channel materials, oxide semiconductors such as ZnO, $(ZnO)_x(SnO_2)_{1-x}$, 90 wt% In_2O_3–10 wt% ZnO, $In_2O_3(ZnO)_2$, and $InGaZnO_4$ have been reported to be as alternatives to α-Si:H in thin-film transistors. Recent results have shown that InZnO has high electron mobility even for room temperature deposition, allowing for use of cheap substrates such as glass for fabrication of TFTs with superior performance to a-Si(H)TFTs.

This book brings together experts in both the GaN and ZnO areas to provide the most up-to-date information on advances in these fields. The topics begin with growth of advanced III-Nitride structures, specifically non-polar growth and high Al content alloys, leading into devices such as green and UV LEDs, HEMT power devices, and sensors. Advances in nitride nanostructures and understanding of radiation defects in GaN are covered, followed by reviews of developments in synthesis and control of ZnO-based films and nanostructures. Finally, the use of amorphous, transparent conducting oxides for channels in TFTs on novel substrates is reviewed. The purpose of the book is to provide both a summary of the current state-of-the-art and directions for future research.

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