LIGHT-EMITTING DIODES

This book covers all aspects of the technology and physics of infrared, visible-spectrum, and white-light-emitting diodes (LEDs) made from III–V semiconductors. The book reviews elementary properties of LEDs such as the electrical and optical characteristics. The author also reviews advanced device physics including high-efficiency device designs, light extraction, radiative and non-radiative recombination dynamics, spontaneous recombination in resonant-cavity structures, and packaging. The reader is introduced to areas related to visible-spectrum and white LEDs such as human vision, photometry, colorimetry, and color rendering. Application of infrared and visible-spectrum LEDs in silica fiber, plastic fiber, and free-space communication is discussed. Extensive semiconductor material data, device design data, and analytic formulas governing the operation of LEDs are provided. Exercises and illustrative examples are used to reinforce the topics discussed. An introductory chapter reviews the historical developments and milestones of LED research and development.

This textbook will be of interest to scientists and engineers working on LEDs, notably in lighting, illumination and signage, and also to graduate students in electrical engineering, applied physics, and materials science.

E. FRED SCHUBERT received his MS degree in Electrical Engineering (Dipl.-Ing.) with honors from the University of Stuttgart, Germany, in 1981, and his Ph.D. degree (Dr.-Ing.) with honors in 1986, also in Electrical Engineering from the University of Stuttgart. From 1981 to 1985 he worked on compound semiconductor crystal growth at the Max Planck Institute for Solid State Research, Stuttgart, as a doctoral student. In 1985, he joined AT&T Bell Laboratories in Holmdel, NJ as a Postdoctoral Fellow. From 1988 to 1995, he was Principal Investigator in the Research Division of AT&T Bell Laboratories in Murray Hill, NJ. In 1995, he joined Boston University and was appointed tenured Full Professor in the Department of Electrical and Computer Engineering and Affiliated Member of the Photonics Center. At Boston University, he was responsible for GaN materials characterization and the fabrication and testing of compound semiconductor devices, in particular GaN-based devices. In 2002 he was appointed Professor of Electrical, Computer, and Systems Engineering at Rensselaer Polytechnic Institute in Troy, New York. At Rensselaer, he holds the Constellation Chair in Future Chips.
LIGHT-EMITTING DIODES

E. FRED SCHUBERT
Rensselaer Polytechnic Institute
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Technical progress in the field of light-emitting diodes (LEDs) has been breathtaking during the last few decades. State-of-the-art LEDs are small, rugged, reliable, bright, and efficient. In contrast to many other light sources, LEDs have the potential of converting electricity to light with near-unity efficiency.

The success story of LEDs has not ended but is still in full progress. Great technological advances will surely continue to be made. As a result, it is expected that LEDs will play an increasingly important role as light sources and will become the dominant light source in the future.

LEDs were discovered by accident early in the last century and the first LED results were published in 1907. LEDs became forgotten only to be rediscovered in the 1920s and again in the 1950s. In the 1960s, several groups pursued the demonstration of semiconductor lasers. The first viable LEDs were by-products in this pursuit. During the last 40 years, LEDs have become devices in their own right and today are versatile light sources with a bright future.

This book is dedicated to the technology and physics of LEDs. It reviews the electrical and optical fundamentals of LEDs as well as advanced device structures. Recent technological breakthroughs are also discussed. The book deals with LEDs made from III–V semiconductors. However, much of the science and technology discussed is relevant to other solid-state light emitters, including emitters made of polymers. Several application areas of LEDs are discussed as well, including illumination and communication applications.

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E. F. Schubert