Preface

Photonics, the science of light generation, manipulation, and detection, has long been the basis for a wide range of key technological applications, including light-emitting diodes (LEDs), lasers, optical fibers, amplifiers, and photodetectors. Exponentially growing interests in photonics has been driven in recent years mostly by novel properties and processes of devices and structures with at least one geometrical dimension between 1 and 100 nm. This book, stimulated by a joint United States and Japan workshop on Nanophotonics in 2008, aims to capture a current snapshot of the burgeoning frontier of nanoscale photonics.

Surface plasmon (SP) is one of the nanophotonic fields experiencing tremendous renewed interest. In “Spontaneous Emission Control in a Plasmonic Structure,” Iwase et al. discuss the quantum electrodynamics of SP polaritons coupling of excitons near metal-layer surfaces, and an exciton embedded in a metal microcavity [??]. Their research should fuel new applications in photoelectric devices and bio-sensing technology. In “Surface Plasmon Enhanced Solid-State Light-Emitting Devices,” Okamoto demonstrates that the SP enhancement of photoluminescence intensities of light emitters is a very promising method for developing high-efficiency LEDs.

In “Polariton Devices Based on Wide-Bandgap Semiconductor Microcavities,” Shimada et al. review the recent progress on cavity polaritons and their applications based on GaN or ZnO wide-bandgap materials. Their research now focuses on the realization of room temperature polariton devices based on these wide-bandgap semiconductor microcavities.

In “Search for Negative Refraction in the Visible Region of Light [??] by Fluorescent Microscopy of Quantum Dots Infiltrated into Regular and Inverse Synthetic Opals,” Moussa et al. reveal the possibility of using infiltrated quantum dots as internal light sources inside the porous photonic crystal for the study of negative-index material effects.

The last four chapters emphasize the diversity and control of photonic properties of different nanostructures from the materials perspective.

In “Self-Assembled Guanosine-Based Nanoscale Molecular Photonic Devices,” Li et al. describe novel hybrid photonic crystals employing a unique material system consisting of a DNA base encapsulated within highly polar GaN nanoscale confined
structures with the aim of developing integrated nanophotonic and biomolecular devices.

The chapter “Carbon Nanotubes for Optical Power Limiting Applications” covers the origin and mechanism of optical power limiting (OPL). Mirza et al. then explore the potential of carbon nanotubes and their composites in OPL applications.

In “Field Emission Properties of ZnO, ZnS, and GaN Nanostructures,” Mo et al. review the growth and field emission properties of ZnO, ZnS, and GaN nanostructures, with an emphasis on ZnO nanorods.

In “Growth, Optical, and Transport Properties of Self-Assembled InAs/InP Nanostructures,” Bierwagen et al. provide an in-depth review of the formation and properties of InAs/InP epitaxial nanostructures, a material system very important for fiber-optic communication operated at 1.55 μm.

Finally, we would like to thank the chapter authors for their efforts and patience which was essential in making this book possible.

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