Preface

The emerging nanophotonics from optics and nanotechnology deals with interaction of light with matter at the nanometer scale. It is the subject of much research and it covers many disciplines in science and engineering. As it is impossible to focus light at the nanometer scale using conventional optical components, we need other techniques like surface plasmonic, metal optic, and metamaterial to confine light at the sub-wavelength scale. The discovery of new phenomena based on the quantum principle, development of a large number of nanostructures and nano devices, and the vast application of nanophotonics have created numerous opportunities for new research areas both on scientific fundamentals and technological applications. Nanophotonic structures and devices are the promising future technology that can revolutionize, to name a few, the optical communications, energy conversion, nanoscale optical sources, integrated information systems, image processing, and sensing devices in all disciplines particularly in nano-medicine. Studies and research in the area of nanophotonics include the fields of, but not limited, plasmonics phenomena and its application, nano sensing devices, nano waveguides, nano optical sources such as LED and LASER, photonic crystals, and quantum optical devices. This book aims to present a collection of research articles on scientific fundamentals, fabrication, and characterization of devices based on nanophotonics, and on related fields.

The book presents 8 chapters divided into 3 sections. The focus of Section 1 is on quantum devices and it contains two chapters. Chapter 1 describes the fundamentals of nanoplasmonics with details of SPR and LSPR followed by their applications. Chapter 2 discusses the physical properties of graphene and its application such as in low-cost touchscreen, nanophonic devices, optoelectronics, photodiodes, and optical communication systems.

Section 2 contains Chapters 3, 4, and 5 dealing with photonic devices. Chapter 3 discusses studies on InAsP quantum dots to generate entangled photon generation and light extraction with a very high efficiency. Chapter 4 deals with the physics of interactions between nuclear particles such as positrons and electrons and hydrogenic targets and its applications. It presents the calculation of photodetachment and photoionization of two-electron systems useful to study the opacity of the sun. Chapter 5 describes the development of photovoltaic devices using perovskite materials like bismuth halide solar cells. The structures and their optoelectronic properties of the devices are reviewed and discussed.

Section 3 deals with the principle of semiconductor materials and devices. It contains Chapters 6, 7, and 8. Chapter 6 covers the principle and control of diffusion and intermixing of atoms in the semiconductor lattices. It summarizes the reported techniques to use the phenomena to create diffused quantum wells (QWs). Examples of QW semiconductor lasers and light-emitting diodes (LED) fabricated using inter-diffusion techniques are also given in Chapter 7. The scope of this chapter is to introduce a highly efficient HfO_2 atomic layer deposition (ALD) process with superior interface defect characteristics that can be applied on high-mobility III-V substrates. The effect of isopropyl alcohol precursor and in situ cyclic

nitrogen plasma treatment on the HfO_2 ALD process at III-V substrates was thoroughly investigated. Chapter 8 discusses the basics of elastic and inelastic scattering. The inelastic scattering, Raman scattering phenomenon and surface-enhanced Raman scattering (SERS), are reviewed in detail. The chapter also discusses the latest developments in the SERS and its applications in various fields including food industries, detection of biomolecules, and in photovoltaic devices such as organic light emitting diodes.

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