Introduction to the Issue on Nanophotonics

NANOPHOTONICS is a rapidly growing field that addresses a broad spectrum of optics on the nanometer scale, covering technology and basic science. Compared to the behavior of isolated molecules or bulk materials, the behavior of nanostructures exhibit important physical properties that are not necessarily predictable from the observations of either individual constituents or large ensembles. Applying the concepts of metallic and dielectric nanostructures to the interaction of light and matter on subwavelength scales can lead to progress in a variety of scientific and technological fields. On the technological side, there are topics such as nanolithography, high-density optical data storage, as well as applications in high-bandwidth communications, efficient solar power generation, displays, biotechnology, and medicine. On the basic sciences end, in addition to the research and development in applications areas, there is a long list of topics including atom–photon interactions in the optical near-field, and their potential applications for atom trapping and manipulation experiments, microscopy and imaging with subwavelength resolution, linear and nonlinear spectroscopy of nanostructures, nanocavities and nanoapertures, light in confined structures, photonic bandgap (PBG) structures, quantum dots, and plasmon optics.

In this issue of the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, we feature papers on the science and technology of nanophotonics. We have 19 invited papers along with seven contributed papers covering a wide range of topics in the latest research areas. Several papers focus on the research on photonic crystals and photonic bandgap structures and applications in integrated optics, beam steering, switching, and optical resonators, as well as nanostructured fibers. Nanoplasmonics utilizing large field enhancement with metallic nanostructures with applications in nanoapertures, subwavelength photonic devices and surface plasmon polariton waveguides are reviewed in detail. More traditional structures in integrated optics utilizing nanofabrication and high-index contrast waveguides are also discussed. Another focus area is photonics metamaterials at optical frequencies and negative index materials. Quantum dots, nanowires, and quantum-well structures for optoelectronic applications in light emitters and photodetectors are reviewed. Two papers are in the emerging new area of nanobiophotonics, discussing its applications in laser nanosurgery and virus detection. The other papers are related to near-field optics, study of Si-based nanocrystals and applications in light amplification, and carbon nanotubes.

We hope you will find this issue on nanophotonics interesting and useful. While we cannot claim a comprehensive coverage of all topics under nanophotonics, we believe that this issue will serve as a valuable reference for the readers.

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