Introduction to the Issue on Quantum and Nanoscale Photonics

WELCOME to the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS (JSTQE) Issue on Quantum and Nanoscale Photonics! While nanophotonics addresses miniaturization of optoelectronic devices and employment of effects resulting from strong localization of light to improve device performance and to achieve new functionalities, quantum photonics focuses on building devices relying on quantum optical effects, including those for applications in quantum information processing.

These rapidly expanding fields have been enabled in part by recent advances in nanofabrication. The nanofabricated structures (both dielectric and plasmonic) offer the opportunity to manipulate light on a chip, and to localize it into optical volumes below subcubic wavelength, thereby increasing local field intensities, and subsequently increasing the strength of light–matter interaction. This in turn can be used to reduce thresholds for effects including lasing and nonlinear frequency conversion. Moreover, such a nanophotonic platform can be combined with quantum emitters (atoms, quantum dots, nitrogen vacancy centers in diamond, etc.), which makes it interesting both as a test bed for quantum optics experiments, as well as a route to build efficient devices for optical interconnects, quantum information processing, and sensitive metrology. A similar platform can be employed to control mechanical modes of the system (in addition to optical modes), which leads to an interesting environment for studying nanooptomechanics.

The purpose of this issue is to highlight the recent progress and trends in the development of novel nano- and quantum photonic technologies. The papers published in this issue cover a broad range of areas, including

1) novel nanophotonic light sources—both classical (lasers) and nonclassical (single- and entangled photon sources);
2) nonlinear optics in nanophotonic structures;
3) quantum optics and quantum information processing based on nanophotonics platform;
4) efficient devices for optical interconnects and optical information processing based on novel nanophotonic structures.

This issue contains 25 papers, including eight invited, authored by well-established research groups and promising scientists from all over the world. The invited papers include extended reviews on entangled photon generation using silicon nanowire waveguides; cavity quantum electrodynamics and lasing oscillation in single quantum dot photonic crystal nanocavity systems; quantum plasmonic circuits; theoretical analysis of few-photon single-atom cavity quantum electrodynamics; semiconductor quantum dot micropillar microcavities for quantum optics in solid state; nanofiber-based optical trapping of cold neutral atoms; switching and counting with atomic vapors in photonic-crystal fibers; and production of multiple diamond-based single-photon sources. The contributed papers cover a broad variety of key nanophotonics and quantum photonics research areas, including recently obtained results on bright single-photon emission from a quantum dot in a circular Bragg grating microcavity, supercontinuum generation in nanostructured silicon waveguides, electrically driven photonic crystal nanocavity devices, and silicon quantum dots.

We hope you will find this issue on quantum and nanoscale photonics to be an interesting and useful reference that will impact and stimulate further advances in this field.

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