

## Progress in Nano-Electro-Optics VI

Nano-Optical Probing, Manipulation, Analysis, and Their Theoretical Bases

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## Preface to Volume VI

This volume contains five review articles focusing on various, but mutually related topics in nano electro-optics. The first article describes recent developments in near-field optical microscopy and spectroscopy. Owing to a spatial resolution as high as 1–30 nm, spatial profiles of local density of states have been mapped into a real space. This clarifies the fundamental aspects of both localized and delocalized electrons in interface and alloy disorder systems. This kind of study for optical probing and manipulation of electron quantum states in semiconductors at the nanoscale is vital to the development of future nanophotonic devices.

The second article is devoted to describing a quantum theoretical approach to an interacting system of photon, electronic excitation and phonon fields on a nanometer scale—a theoretical basis for nanophotonics. It discusses the phonon's role and localization mechanism of photons in such a system. It allows us not only to understand an elementary process of photochemical reactions with optical near fields, but also to generally explore phonons' roles in nanostructures interacting with localized photon fields.

The third article concerns the visible laser desorption/ionization of bio-molecules from the gold-coated porous silicon, gold nanorod arrays and nanoparticles. Interesting phenomena have been observed to clearly suggest near-field effects on the desorption/ionization mechanism. The techniques presented offer a potential analytical method for the low-molecular weight analytes that are rather difficult to handle in the conventional matrix-assisted laser desorption/ionization (MALDI) mass spectrometry.

The fourth article deals with a near-field optical lithography (NFOL) as an instance of nanofabrication using optical near fields, a method which is not affected by the diffraction limit of light. A bilayer resist process has been developed that enables one to form fine patterns on a structure with a practical aspect ratio. This process was successfully applied to an ultraviolet second harmonic generation (SHG) wavelength

conversion device. These technologies are expected to provide a practical fabrication method for optical devices.

The last article reviews recent advances in optical manipulation of nanometric objects using resonant radiation force. Theoretical bases and unified expressions applicable to the different-size regimes—i.e., from the atomic to macroscopic regimes—are presented. According to the theoretical predictions obtained, experimental achievements are described on optical transport of nanoparticles in superfluid  $^4\text{He}$ , selectively manipulated by the resonant radiation force.

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I hope that this volume will be a valuable resource for readers and for future specialists.

Tokyo  
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