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Motoichi Ohtsu (Ed.)

Progress in Nano-Electro-Optics IV

Characterization of Nano-Optical Materials and Optical Near-Field Interactions

With 123 Figures

Springer
Recent advances in electro-optical systems demand drastic increases in the degree of integration of photonic and electronic devices for large-capacity and ultrahigh-speed signal transmission and information processing. Device size has to be scaled down to nanometric dimensions to meet this requirement, which will become even more strict in the future. In the case of photonic devices, this requirement cannot be met only by decreasing the sizes of materials. It is indispensable to decrease the size of the electromagnetic field used as a carrier for signal transmission. Such a decrease in the size of the electromagnetic field beyond the diffraction limit of the propagating field can be realized in optical near fields.

Near-field optics has progressed rapidly in elucidating the science and technology of such fields. Exploiting an essential feature of optical near fields, i.e., the resonant interaction between electromagnetic fields and matter in nanometric regions, important applications and new directions such as studies in spatially resolved spectroscopy, nanofabrication, nanophotonic devices, ultrahigh-density optical memory, and atom manipulation have been realized and significant progress has been reported. Since nanotechnology for fabricating nanometric materials has progressed simultaneously, combining the products of these studies can open new fields to meet the above-described requirements of future technologies.

This unique monograph series entitled “Progress in Nano-Electro-Optics” is being introduced to review the results of advanced studies in the field of electro-optics at nanometric scales and covers the most recent topics of theoretical and experimental interest on relevant fields of study (e.g., classical and quantum optics, organic and inorganic material science and technology, surface science, spectroscopy, atom manipulation, photonics, and electronics). Each chapter is written by leading scientists in the relevant field. Thus, high-quality scientific and technical information is provided to scientists, engineers, and students who are and will be engaged in nano-electro-optics and nanophotonics research.

I gratefully thank the members of the editorial advisory board for valuable suggestions and comments on organizing this monograph series. I wish to express my special thanks to Dr. T. Asakura, Editor of the Springer Series in Optical Sciences, Professor Emeritus, Hokkaido University for recommending me to publish this monograph series. Finally, I extend an acknowledgement to
Preface to *Progress in Nano-Electro-Optics*

Dr Claus Ascheron of Springer-Verlag, for his guidance and suggestions, and to Dr H. Ito, an associate editor, for his assistance throughout the preparation of this monograph series.

Yokohama, October 2002

*Motoichi Ohtsu*
Preface to Volume IV

This volume contains four review articles focusing on different aspects of nano-electro-optics. The first chapter reviews a versatile scanning near-field optical microscope with magnetic contrast by utilizing a Sagnac interferometer for monitoring the magneto-optical Kerr effect. This microscope is used to characterize data-storage media as well as to study the formation of micromagnetic patterns in ultrathin magnetic films.

The second chapter aims at describing how to achieve high-quality T-shaped quantum wires with high spatial uniformity. To characterize local structural and optical properties in quantum wires, a high-resolution microscopic photoluminescence method is used. Lasing from a single-quantum-wire laser structure is also demonstrated.

The third chapter summarizes material parameters of InGaN, and then general transition modes are discussed based on screening of the piezoelectric field, as well as on localization behavior of exciton/carriers. Detailed results are also shown on near-field luminescence mapping in InGaN/GaN single-quantum-well structures in order to interpret the recombination mechanism in InGaN-based nanostructures.

The last chapter concerns the theoretical treatments of optical near field and optical near-field interactions. The half-space problems are solved based on the angular-spectrum representation of the scattered field, where the energy transfer between interacting objects is made clear. This treatment provides the basis to investigate the signal transport and associated dissipation in nano-optical devices.

As was the case of Volumes I–III, this volume is published by the support of an associate editor and members of the editorial advisory board. They are:

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

Tokyo, July 2004

Motoichi Ohtsu
Near-Field Imaging of Magnetic Domains
Gereon Meyer, Andreas Bauer, Günter Kaindl

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