Near Field Characterization Of Micronano Scaled Fluid Flows Experimental Fluid Mechanics

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The near-field region within an order of 100 nm from the solid interface is an exciting and crucial arena where many important multiscale transport phenomena are physically characterized, such as flow mixing and drag, heat and mass transfer, near-wall behavior of nanoparticles, binding of bio-molecules, crystallization, surface deposition processes, just naming a few.

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The near-field region within an order of 100 nm from the solid interface is an exciting and crucial arena where many important multiscale transport phenomena are physically characterized, such as flow mixing and drag, heat and mass transfer, near-wall behavior of nanoparticles, binding of bio-molecules, crystallization, surface deposition processes, just naming a few. This monograph presents a number of label-free experimental techniques developed and tested for near-field fluid flow characterization. Namely, these include Total Internal Reflection Microscopy (TIRM), Optical Serial Sectioning Microscopy (OSSM), Surface Plasmon Resonance Microscopy (SPRM), Interference Reflection Contrast Microscopy (IRCM), Thermal Near-Field Anemometry, Scanning Thermal Microscopy (STM), and Micro-Cantilever Near-Field Thermometry. Presentation on each of these is laid out for the working principle, how to implement the system, and its example applications, to promote the readers understanding and knowledge of the specific technique that can be applied for their own research interests.

This volume focuses on the characterization of nano-optical materials and optical near-field interactions. It begins with the techniques for characterizing the magneto-optical Kerr effect and continues with methods to determine structural and optical properties in high-quality quantum wires with high spatial uniformity. Further topics include: near-field luminescence mapping in InGaN/GaN single quantum well structures in order to interpret the recombination mechanism in InGaN-based nano-structures; and theoretical treatment of the optical near field and optical near-field interactions, providing the basis for investigating the signal transport and associated dissipation in nano-optical devices. Taken as a whole, this overview will be a valuable resource for engineers and scientists working in the field of nano-electro-optics.

Recent advances in technologies have created a need for sensing and measuring temperature at the nanoscale. This challenge requires new approaches and new techniques, since conventional thermometry is not valid at this scale. Thermometry at the Nanoscale covers the fundamentals of the subject, followed by individual chapters on luminescence-based and non-luminescence based thermometry techniques, and finally specific chapters on different applications of nanothermometry. The fundamental topics covered include a review of temperature measurement, the meaning of temperature on the nanoscale and heat propagation at the nanoscale. Luminescence-based techniques covered include quantum dots thermometry; lanthanide phosphors thermometry; organic dyes thermometry; polymer-based thermometry and organic-inorganic hybrids thermometry. Non-luminescence based thermometry techniques include scanning thermal microscopy; near-field thermometry and nanotubes thermometry. The range of applications of nanothermometry discussed includes thermometry inside a cell; microelectronics and micro/nanonofluidics. This is the first book to cover the whole subject of thermometry at the nanoscale with specialists in each particular technique discussing in detail the recent achievements and limitations as well as future trends and technological possibilities. The book will appeal to researchers from materials science, physical chemistry, analytical chemistry and biological sciences working on the development of new materials, materials characterisation/analysis and their applications.

This book shows an update in the field of micro/nano fabrications techniques of two and three dimensional structures as well as ultimate three dimensional characterization methods from the atom range to the micro scale. Several examples are presented showing their direct application in different technological fields such as microfluidics, photonics, biotechnology and aerospace engineering, between others. The effects of the microstructure and topography on the macroscopic properties of the studied materials are discussed, together with a detailed review of 3D imaging techniques.

This thesis focuses on a means of obtaining, for the first time, full electromagnetic imaging of photonic nanostructures. The author also develops a unique practical simulation framework which is used to confirm the results. The development of innovative photonic devices and metamaterials with tailor-made functionalities depends critically on our capability to characterize them and understand the underlying light-matter interactions. Thus, imaging all components of the electromagnetic light field at nanoscale resolution is of paramount importance in this area. This challenge is answered by demonstrating experimentally that a hollow-pyramid aperture probe SNOM can directly image the horizontal magnetic field of light in simple plasmonic antennas rod, disk and ring. These results are confirmed by numerical simulations, showing that the probe can be approximated, to first order, by a magnetic point-dipole source. This approximation substantially reduces the simulation time and complexity and facilitates the otherwise controversial interpretation of near-field images. The validated technique is used to study complex plasmonic antennas and to explore new opportunities for their engineering and characterization.

Subwavelength and Nanometer Diameter Optical Fibers provides a comprehensive and up-to-date coverage of research on nanoscale optical fibers including the basic physics and engineering aspects of the fabrication, properties and applications. The book discusses optical micro/nanofibers that represent a perfect fusion of optical fibers and nanotechnology on subwavelength scale and covers a broad range of topics in modern optical engineering, photonics and nanotechnology spanning from fiber optics, near-field optics, nonlinear optics, atom optics to nanofabrication and microphotonic components/devices. It is intended for researchers and graduate students in the fields of photonics, nanotechnology, optical engineering and materials science. Dr. Limin Tong is a professor at Department of Optical Engineering and State Key Laboratory of Modern Optical Instrumentation of Zhejiang University, China; Dr. Michael Sumetsky is a researcher at OFS Laboratories, USA.

Proceedings of SPIE present the original research papers presented at SPIE conferences and other high-quality conferences in the broad-ranging fields of optics and photonics. These books provide prompt access to the latest innovations in research and technology in their respective fields. Proceedings of SPIE are among the most cited references in patent literature.

This book offers a comprehensive review of the state-of-the-art in innovative Beyond-CMOS nanodevices for developing novel functionalities, logic and memories dedicated to researchers, engineers and students. It particularly focuses on the interest of nanostructures and nanodevices (nanowires, small slope switches, 2D layers, nanostructured materials, etc.) for advanced More than Moore (RF-nanosensors-energy harvesters, on-chip electronic cooling, etc.) and Beyond-CMOS logic and memories applications.

Implantable microdevices, providing accurate measurement of target analytes in animals and humans, have always been important in biological science, medical diagnostics, clinical therapy, and personal healthcare. Recently, there have been increasing unmet needs for developing high-performance implants that are small, minimally-invasive, biocompatible, long-term stable, and cost-effective. Therefore, the aim of this Special Issue is to bring together state-of-the-art research and development contributions that address key challenges and topics related to implantable microdevices. Applications of primary interest include, but are not limited to, miniaturized optical sensing and imaging tools, implantable sensors for detecting biochemical species and/or metabolites, transducers for measuring biophysical quantities (e.g., pressure and/or strain), and neural prosthetic devices.

This book focuses on a research field that is rapidly emerging as one of the most promising ones for the global optics and photonics community: the lab-on-fiber technology. Inspired by the well-established "lab on-a-chip" concept, this new technology essentially envisages novel and highly functionalized devices completely integrated into a single optical fiber for both communication and sensing applications. Based on the R&D experience of some of the world's leading authorities in the fields of optics, photonics, nanotechnology, and material science, this book provides a broad and accurate description of the main developments and achievements in the lab-on-fiber technology roadmap, also highlighting the new perspectives and challenges to be faced. This book is essential for scientists interested in the cutting-edge fiber optic technology, but also for graduate students.