

Preface

With the development of electro-optical technology, nano-Sci and Tech., and life science and biology, the light imaging resolution, lithographic linewidth, and optical information mark size are required to reach down to subwavelength or even nanoscale. However, these are restricted by the Abbe limit due to the diffraction effect. Researchers have proposed a number of methods to fight against the Abbe limit. These methods can be classified into two kinds, one is to change the point spread function, such as scanning near-field optical probe microscopy, liquid (solid) immersion lens, and phase-only pupil filter, etc. The other is to improve the resolution through detecting the fluorescence signal, such as photo-activated localization microscopy (PALM) and stochastic-optical reconstruction microscopy (STORM), which are generally used in biomedical and life science. The stimulated emission depletion (STED) is an excellent combination of two kinds of techniques mentioned above. The STED is mainly used in biomedical imaging and life science, and is also explored to apply to nanolithography in recent years.

This book first introduces the principle and technical schematics of common methods for realizing nanoscale spot (Chap. 1), describes the third-order nonlinear effects and characterization methods (Chaps. 2 and 3), and then analyzes the strong nonlinear characteristics (including nonlinear absorption and refraction) of semiconductor and metal-doped semiconductor thin films (Chap. 4). Chapters 5–7 focus on nonlinearity-induced super-resolution effects, including nonlinear saturation absorption-induced aperture-type super-resolution, nonlinear refraction-induced self-focusing and interference-manipulation super-resolution, and the combination of nonlinear thin films and phase-only pupil filters to compress the side-lobe intensity and reduce the main spot size to nanoscale. Applications in high-density optical information storage, nanolithography, and high-resolution light imaging are presented in Chaps. 8 and 9, and some remarks are given at the end of the book.

I hope that this book can drive nano-optics and nanophotonics to continue to advance. The book is helpful for advanced undergraduates, graduate students, and researchers and engineers working in related fields of nonlinear optics, nano-optics and nanophotonics, information storage, laser fabrication, and lithography,

and light imaging etc. It is unavoidable that some errors and incorrectness may occur in this book, I hope that the readers can point them out. I also will further correct them and improve my work on future releases.

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