

Preface

Localized surface plasmon resonance (LSPR) is a phenomenon that occurs in noble-metal nanoparticles with dimensions (3–100 nm) much smaller than the wavelength of incident light (400–900 nm). The active surface electrons of nanoparticles exhibit collective oscillation upon excitation by incoming light. Because of the small size of the nanoparticles, the electrons are confined within the nanoparticle surface area and are unable to propagate. When the frequency of the incoming photons overlaps with the frequency of the electrons as they oscillate against the restoring forces of the positive nuclei, plasmon resonance is generated. Because of their LSPR properties, plasmonic nanoparticles exhibit characteristic scattering and absorption bands that make them excellent nanoprobes for a variety of applications.

In this book, we focus primarily on the plasmonic applications in biosensing and attempt to provide an overview of the different operating principles of plasmonic sensors, particularly single-nanoparticle-based detections. In Part I, we introduce the basic theory of surface plasmon resonance according to Maxwell's equations and Mie theory to explain the photon–electron interaction mechanism and resonance conditions. Part II highlights the applications of nanoplasmonics in biosensors. As the LSPR band is dependent on the particle size, shape, composition, and surrounding medium, we therefore present a series of creative biosensor designs that are based on the modulation of these nanoparticle parameters for label-free detection. [Chapter 5](#) reviews the interparticle coupling effect, in which closely spaced nanoparticles experience LSPR coupling that causes distinct intensity and wavelength changes. Through this mechanism, distance-controlled plasmon resonance enables ultra-sensitive detection even at the single-molecule level. In [Chap. 6](#), we summarize the discovery of plasmon resonance energy transfer and its utilization in the detection of biomolecules and heavy-metal ions. In [Chap. 7](#), we discuss the electron transfer on plasmonics surface as well as its influence on charge separation of semiconductors. The use of nanoplasmonics in living cell imaging and photothermal therapy is emphasized in [Chap. 8](#). Finally, in [Chap. 9](#), we summarize the importance of LSPR and nanosensors and propose the development of future plasmonic applications.

We hope this booklet will help researchers with expertise or interest in plasmonics to gain a general understanding of its fundamental theory and applications.

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Nanobiosensors

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