

# Surface Plasmon Polaritons (SPPs) and Its Applications: A Study

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**Abstract:** In this paper investigation is done related to understanding of the excitation of SPPs and their interaction with the features related to the surface of metals. The dispersion of light from the nanostructured metal surface is the result of that interaction. In this article, a brief review of the theoretical work on the production of hot carriers on the basis of SPPs is presented.

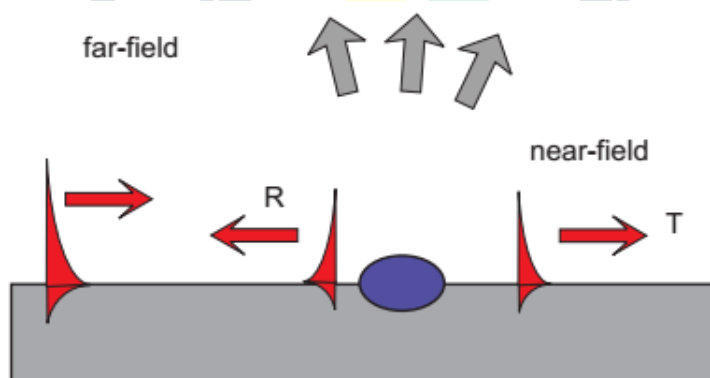
**Keywords:** Surface plasmon polariton (SPPs), Scanning Near-Field Optical Microscopy (SNOM), Hot Carriers, Optical Sensors

## 1. Introduction

A short review will benefit the readers to understand the excitation of surface plasmon polaritons (SPPs) and their propagation along the metal-dielectric interface. This work enables the readers to understand the background theory of SPPs as well as the overview of recent applications in the field of Plasmonics. It is preferred over previous articles because the underlying physics of SPPs is presented with experimental as well as theoretical results which explains wide range of applications of SPPs in different fields of science. The earlier literature in this field is outdated and there is a firm need to discuss the advancement in the applications of SPPs during the recent years.

## 2. Theoretical and Experimental Approach

In this section, surface plasmon polariton scattering and backscattering by using SNOM technique is presented. At the end, theoretical verification of SPPs as hot carriers is also discussed.



**Figure-1** Schematic shows the scattering phenomena of SPPs on a “metal-dielectric” interface [9,40].

## 3. Applications of SPPs

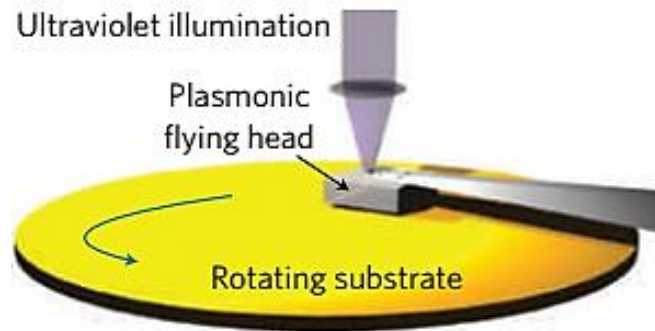
SPP has a wide variety of features and implementations. Some of those are outlined below:-

### 3.1 Plasmonic Bandgap

The optical devices can be controlled by modifying their optical properties through photonic materials. The propagation of light can be inhibited due to the formation of photonic bandgap in the dispersion curves of the materials that have made up of periodically different refractive index. For 3D photonic crystals, photonic bandgaps in the microwave regime was reported by Yablonovitch [37,38]. When a metallic grating as Plasmonic band gap (PBG)(Muhammad Javaid, 2015) which directly finds its applications in surface-enhanced Raman scattering (SERS)[36].

### 3.2 Nanolithography

The field of Plasmonic offers several applications in nanolithography. For this purpose, extraordinary transmission is used which was discovered by T.W. Ebbesen in 1998. In order to minimize the feature size of electronic devices to about 50nm, a lithographic technique needs to be established to fabricate such type of integrated circuits with smaller dimensions [30].



**Figure-2** Plasmonic flying head for nanolithography using ultraviolet light and rotating substrate. (Schuller *et al.*, 2010)

So, in order to reach the anticipated feature size, an optical lithography at shorter optical wavelengths can be used. When the wavelength becomes smaller and smaller, the light sources like photoresists and optics are increasingly more complex. Plasmonic flying head for nanolithography using ultraviolet light and rotating substrate is shown in Figure-10. So, by making further improvements in uniformity and sub wavelength resolution, plasmonic nanolithography can be used as a best alternative to other Nano lithographic systems.

### 3.3 Telecommunication

Plasmonic devices of specific geometrical parameters have ability to excite SPPs by coupling desired incident frequencies, which can be used to design filters.

### 3.4 Electronic Devices

Photonic band gap has wide range applications to reduce noise especially in electronic devices such as laser diodes, light emitting diodes (LEDs) etc. The plasmonic materials are biocompatible, have high mechanical strength, excellent thermal and electrical conductivity which make them useful for biological and chemical sensors.

## 4. Conclusion

The study reveals that the the field of Plasmonic offers several applications in nanolithography. For this purpose, extraordinary transmission is used which was discovered by T.W. Ebbesen in 1998. In order to minimize the feature size of electronic devices to about 50nm, a lithographic technique needs to be established to fabricate such type of integrated circuits with smaller dimensions [30]. It can be used in various industrial and manufacturing operations.

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