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**Using Light confined into Surface Plasmon Polaritons**

Plasmonic is a promizing field for many applications in nanophotonics. When an optical wave excites a metallic nanostructure at its plasmon resonance, the local electromagnetic field is confined in a nanometric area. This localization is bound at the interface between the metal and the surrounding dielectric. The field of plasmonic can be divided in two: Localized Surface Plasmon Resonance (LSPR) from nanoparticles and the propagating Surface Plasmon Polaritons (SPP) between thin film layers. In this talk I will discuss about these two resonances in three topics.

**1. Coherence of fluorescence induced by surface plasmon.**

In this first part, I will discuss about a very important optical property which is the coherence. We measured the spatial coherence of these plasmons in flat silver films and we show that only the propagation length of SPPs are limiting the coherence. Strikingly, when fluorescent emitters are deposited on the same silver surface, even incoherent and independent emitters will boost their coherence. Indeed, when local emitters are coupled in the near-field to SPP, their fluorescence will decay very fast inside the SPP channel.

From this new property an original method will be discussed to use the coherence to measure surface waves in a wide range of complex systems [1].

**2. Plasmonic Hybridization.**

In a second part of this presentation, I will present new devices based on plasmonic hybridization. When two atoms are coupled together, new energy levels can be created by hybridization leading to bonding and antibonding modes. In a similar way, if a very thin metallic layer is inserted in a symmetric environment (for example a gold layer inserted in between 2 glass layers), the SPP bound at each interface can hybridize. This leads to the appearance of a LongRange plasmon which can propagate over extended distances. A theoretical as well as an experimental realization will be presented and discussed where the fluorescence of molecules inserted in this device can be guided over tens of micrometers [2]. A theoretical idea will be given towards the creation of energy continuum induced by multi-hybridizations.

**3. Polarized nanopatch antennas.**

Plasmonic hybridizations offer new concepts to engineer all kind of devices for light applications. In this last part, I will present very recent results about a device which consist of a single gold nano-Bipyramid (AuBPs) located near a gold film. In a first step, the 3D orientations of AuBPs deposited on glass have been successfully measured by polarimetric analysis. We found two kinds of orientations: where some AuBPs are parallel or tilted on their faces [3]. The knowledge of the deposition processes is very important to understand the coupling when AuBPs are deposited at a controlled distance (with titan-dioxide of a few nm) near a gold surface. At the time of this talk, we are currently working on the coupled devices and we find that the coupled system (AuBP and gold surface) acts as a nano-antenna to scattered light or launch SPP.

Some perspectives will be discussed such as to use these coupling between surface plasmons and emitters for many applications such as light guiding, redirection, polarization enhancement …

[1] **Influence of surface plasmon propagation on leakage radiation microscopy imaging**

S. Aberra. Guebrou, J. Laverdant, C. Symonds, S. Vignoli, F. Bessueille and J. Bellesssa., Appl. Phys. Lett. 101, 123106 (2012)

[2] **Coupling a single dipole to a longrange surface plasmon polariton device**, C.N. VU & J. LAVERDANT, Optics Letters Vol. 45, Issue 18, pp. 5193-5196 (2020)

[3] **Single gold bipyramid orientation measured by scattering polarization spectroscopy**, C.N. VU, Z. OUZIT, A. MAITRE, L. COOLEN, F. LEROUGE & J. LAVERDANT, J. Phys. Chem. Letters, 2021,12, 2, 752