NanoSaclay

Laboratoire d'Excellence
en Nanosciences et Nanotechnologies

Colloquium Nanophotonique

Splendeurs et misères des Metamaterials
(Dealing with loss in plasmonics and metamaterials)

Jacob B. Khurgin

John Hopkins University

Baltimore, Maryland,

Recent years have seen staggering growth of interest in using nanostructured metals in optical range with the goal of enhancing linear and nonlinear optical properties or even engineering novel optical properties unknown in Nature - usually this burgeoning field is referred to as "Plasmonics and Metamaterials". After the initial years of excitement the community is belatedly beginning to recognize that loss in the metal is an important factor that might impede practical application of plasmonic devices, be it in signal processing, sensing, imaging or more esoteric applications like cloaking. Yet there is still an optimism that the loss can be either cleverly "designed away", compensated by gain, or a new lossless materials can be found. In this course we examine these concepts one by one. First, based entirely on energy-conservation considerations, we explain why subwavelength confinement requires metal or another material with negative permittivity. We demonstrate that in truly sub-wavelength metal structures the metal loss is inherent and cannot be engineered away by crafty changes in shape. Then we show that when it comes to enhancing the device performance (solar cells, sensors, nonlinear optical devices, etc.) only the most inefficient devices can be improved by plasmonics while the performance of any decent device will only degrade. Then we consider idea of compensating loss using semiconductor gain medium and demonstrate that required gain can never be achieved due to increase in recombination rates caused by Purcell effect. We then show that negative dielectric constant at optical frequencies does not have to inevitably lead to large absorption, and guardedly point to the tentative way in which new materials with negative dielectric constant and very low loss might be synthesized, thus restoring the hope for plasmonics.

AUDITORIUM
Institut d'Optique
2 Av Fresnel, 91127 Palaiseau

Vendredi 23 octobre 2015 à 10h30

NanoSaclay