Nano-plasmonic devices: an introduction

Course at a Glance

Theoretical fundamentals on plasmonics; electromagnetic field on metallic nano-structures; applications.

Instructors

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Credits: 3

Synopsis

Plasmonics is a branch of Physics extremely promising for its applications in electronics, chemistry, computer science, solar energy harvesting and biology. In particular, it is dedicated to the investigation of confined electromagnetic waves originating by the combination of free electrons with the light source. Besides noble metals, artificial materials are at the base of Plasmonics. This aspect strictly relates it to Nanotechnology, a growing science aiming to investigate both the theoretical and fabrication aspects of devices with dimensions in the nanometer range.
In the present course will focus on a general introduction to plasmonics providing also the physical [1] and mathematical tools to predict the electromagnetic behaviour of plasmonic nano-devices. Among the many examples where plasmonics and nanotechnology are combined, we shall introduce devices for light concentration [2], biological analysis [3] and light harvesting [4].

Syllabus

The course develops in about 9/10 hours in the classroom.

- Fundamental concepts underneath plasmonics
- Surface plasmon polaritons vs. localized plasmons
- Key advantages of plasmonics
- Plasmonics and its applications

The examination consists in a journal club or a brief research project proposal.

Reading list

[1] Alessandro Alabastri, Salvatore Tuccio, Andrea Giugni, Andrea Toma, Carlo Liberale, Gobind Das, Francesco De Angelis, Enzo Di Fabrizio and Remo Proietti Zaccaria,
"*Molding of plasmonic resonances in metallic nanostructures: dependence of the non-linear electric permittivity on system size and temperature*",
Materials 6, 4879-4910 (2013).
[2] Remo Proietti Zaccaria, Alessandro Alabastri, Francesco De Angelis, Gobind Das, Carlo Liberale, Andrea Toma, Andrea Giugni, Luca Razzari, Mario Malerba, Hong Bo Sun, and Enzo Di Fabrizio,
"*Fully analytical description of adiabatic compression in dissipative polaritonic structures*",
Physical Review B 86, 035410 (2012).
[3] Manola Moretti, Remo Proietti Zaccaria, Emiliano Descrovi, Gobind Das, Marco Leoncini, Carlo Liberale, Francesco De Angelis, and Enzo Di Fabrizio,
"*Reflection-mode TERS on insulin amyloid fibrils with top-visual AFM probes*",
Plasmonics 8,25 (2013).

[4] Wenli Bai, Qiaoqiang Gan, Filbert Bartoli, Jing Zhang, Likang Cai, Yidong Huang, and Guofeng Song,
"Design of plasmonic back structures for efficiency enhancement of thin-film Si solar cells", Optics Letters 34, 3725 (2009).

Venue
IIT - Via Morego 30, 16163 Genova

Course date
October - November 2015