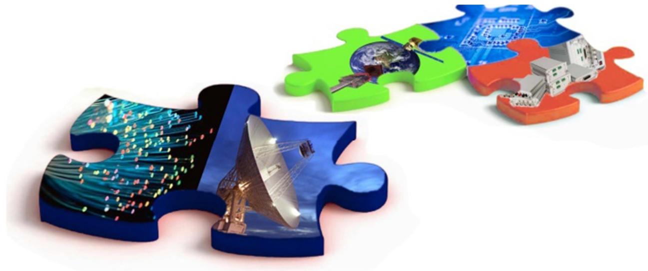
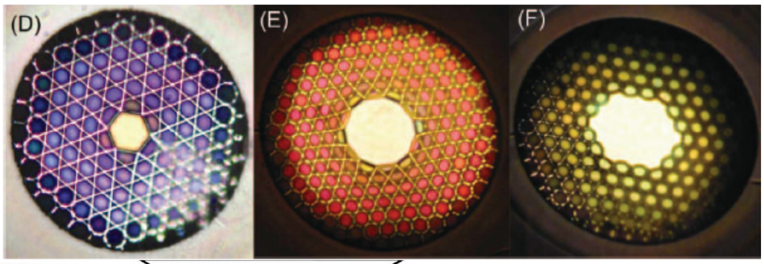
Photonics and Electromagnetic Engineering (PhEm) Lab

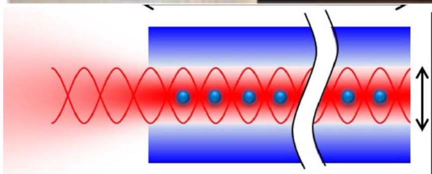
PROPOSTE di TESI

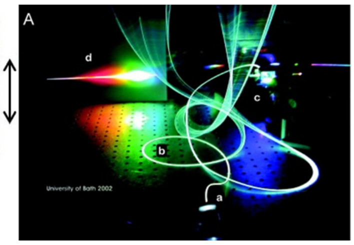
PhEm Lab



Photonic Crystal Fibers analysis and design

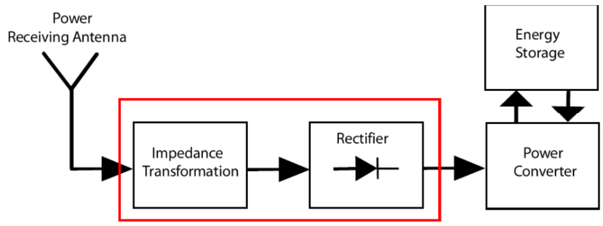


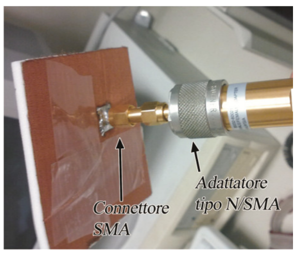


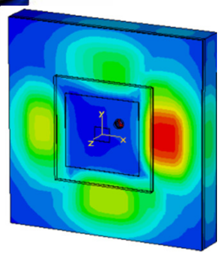


Photonic Crystal Fibers have been changing the way light is generated, delivered and used. In this framework Hollow Core Fibers are a revolution in light guiding with enormous potential: ultra low loss, ultra low dispersion, long interaction length, low dielectric overlap are very useful features in telecommunications, sensing, gas laser technology, biophotonics, terahertz technology, micro-machining and micro surgery. The activity concerns the investigation and analysis of the waveguiding mechanism in order to improve the fibers' performances and it will be performed in collaboration with the **Gas-Phase Photonic and Microwave Materials group** (GPPMM) of Xlim CNRS research Institute, University of Limoges, **France**.

Antenna design for RFID and RFEH applications



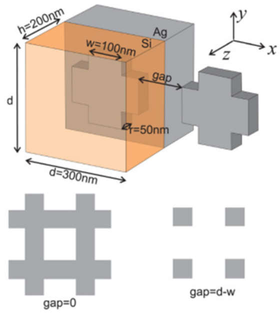




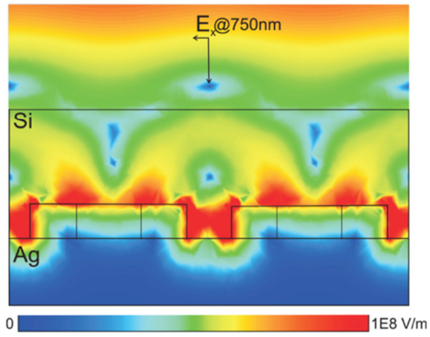
Scavenging the electromagnetic energy radiated in the ISM band is a fascinating option for the development of remote power supply solutions for ultra-low power devices like wireless sensor networks - WSN nodes and RFID active tags. The very low power available at the receiver side requires the RF power supply module to meet severe challenges in terms of sensitivity and efficiency. Usually to get that target, chips containing rectifier circuits exhibit a complex input impedance with a small resistance, and a high capacitive reactance. Since matching networks cannot be used in order to minimize power loss, an impedance matching between chip and antenna is required.

The activity concerns the design, realization, and measurement of the main parameters of antennas aforementioned characteristics.

PLASMONIC NANOSTRUCTURE FOR EFFICIENT PHOTOVOLTAICS

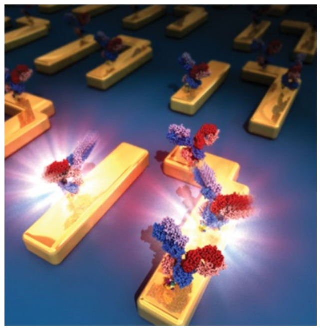


Nanoplasmonic-enhanced photovoltaics (PV) have received much recent interest because of its possibility to improve absorption efficiency of thin solar cells. In particular, organic solar cells with ultrathin active layers have attracted tremendous research due to their potential in low-cost and flexible PV devices. Poor solar absorption in polymer thin-films, however, hampers real-world device development in this area. Achieving high energy conversion efficiency requires incident sunlight to be absorbed as much as possible, over a broad bandwidth and a broad range of incident angles. It is essential to optimize light-trapping plasmonic devices in order for thin-film OSCs to efficiently absorb sunlight, which improves power conversion efficiencies when compared to other thin-film solar cells based on silicon (Si) or gallium arsenide (GaAs).



GOAL: Design of broad-band/multilayer plasmonic nanosurface for enhanced light trapping

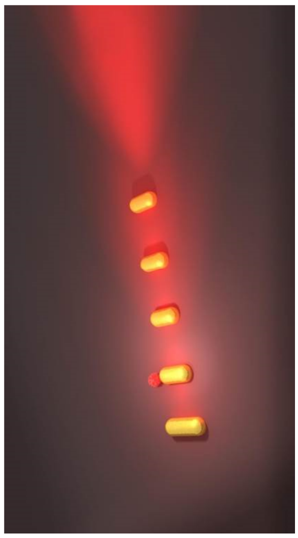
PLASMONIC BIOSENSORS



Recent developments have greatly improved the sensitivity of optical sensors based on metal nanoparticle arrays and single nanoparticles. In particular, it has been shown how localized surface plasmon resonance (LSPR) and surface plasmon polariton (SPP) nano-sensors exhibit sensitivity to size, shape and environment that can be harnessed to detect molecular binding events and changes in molecular conformation. But there is still the need for pushing sensitivity towards the single-molecule detection limit, combining LSPR with complementary molecular identification techniques such as surface-enhanced Raman spectroscopy, and practical development of sensors and instrumentation for routine use and high-throughput detection.

GOAL: Design of high sensitivity plasmonic sensor

OPTICAL NANOANTENNAS



Control of the characteristics of the plasmonic nano-antennas opens the possibility for a variety of practical and prospective applications including enhanced sensing and spectroscopy, plasmonic sensors and biosensors, cancer imaging and therapy, building blocks of metamaterials, the ability to redirect scattered light, plasmonic lasers, enhanced nonlinearities, enhancement of radiation efficiencies, enhancement of the Raman signal (SERS) and many more. Many configuration have been investigated so far, demonstrating the rapid interest of the scientific community.

GOAL: Tuning both the electric and magnetic plasmonic response of a nanoantenna