



PhD Proposal 2017

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Collaboration with other partner during this PhD:	
In France:	In China:

Title: Toward new materials in nano-optics
Scientific field: Nano-optics
Key words: plasmonics, nanoparticles

Details for the subject:

Background, Context:

Nanoplasmonics, based on the use of metal nanoparticles in nano-optics, is a very active area of research with numerous applications in physics, chemistry, biology and biomedicine. So far, gold has been the most popular candidate for most applications in plasmonics, but gold nanoparticles suffer from some limitations that make them unsuitable for some important applications, for example involving high temperature or requiring catalytic activity of the nanoparticle.

Today, a new research thematic is raising, consisting in looking for new materials in plasmonics, that could outperform noble metals. In particular, metal nitrides (TiN, ZrN, HfN) have been foreseen to replace gold in some applications, *e.g.* heat assisted magnetic recording or thermophotovoltaics.

Research subject, work plan:

The objective of the thesis is to investigate new materials for plasmonics that consist of an alloy of metal nitrides and gold ($Au_xTi_yN_z$, $Au_xZr_yN_z$). Such a new class of materials in plasmonics is expected to cumulate the benefits of gold (gigantic plasmonic resonance, inertness, biocompatibility, easy chemical functionalization), and metal nitrides (high temperature sustainability, CMOS compatibility). Three research axes are associated with this project:

- Thin films of the new alloys will be fabricated by electron-beam evaporation in order to measure their optical properties (namely their permittivity).
- From these measurements, numerical simulations will be conducted to estimate their plasmonic efficiencies. The aim will be to identify the evaporation conditions to obtain the best plasmonic material.
- Using e-beam lithography, alloy nanoparticles will be fabricated and their optical properties will be characterized using the broad range of optical microscopies accessible at the institut Fresnel. In particular, a thorough characterization will be conducted on the photothermal effects, scattering properties, non-linear absorption, two photon luminescence and second harmonic generation.

For this project we seek a candidate willing to conduct both theoretical and experimental activities. A solid background in optics will be a strong asset.

References:

guillaume.baffou.com/publications.php