Centre de Nanosciences et de Nanotechnologies

Soutenance de thèse

Vendredi 15 novembre 2019

14h30

Antu GORTARI

"Metasurfaces for bioimaging"

Jury members:

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Abstract :

In recent years there has been a significant effort to push electromagnetic metasurfaces with the ability to abruptly change light properties into visible wavelengths. These advancements have opened a new range of possibilities to reshape light using ultra-thin optical devices and there is one field that is starting to gather attention: bioimaging. One technique particularly well suited for the study of molecules near a cell membrane is Total Internal Reflection Fluorescence (TIRF) microscopy, which relies on an evanescence field created by light being totally internally reflected within a glass substrate due to its high incidence angle. As of today, TIRF is generally implemented using bulky high-NA, small field of view oil objectives.

In this project we present the realization of metasurface-based TIRF microscopy substrates consisting of periodic 2D arrays of asymmetric structures fabricated in titanium dioxide on borosilicate glass. These patterns, as small as 48nm, were optimized through rigorous coupled-wave analysis to couple 50-90% of the incoming normally incident light into the first diffraction order, which outputs at an angle that suffices total internal reflection in water and eliminates the requirement for high NA objectives or prisms to achieve TIRF. Being able to utilize lower-magnification air objectives and having a large evanescence field area provide unique TIRF conditions not accessible by traditional methods. Additionally, these structures are compatible with soft UV nanoimprint lithography, for cost-effective scale production, to give TIRF's high contrast, low photodamage and low photobleaching capabilities to inexpensive wide-field microscopes

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