Master 2 Internship

Title: A stunning combination between a femtosecond laser and a scanning near-field microscope

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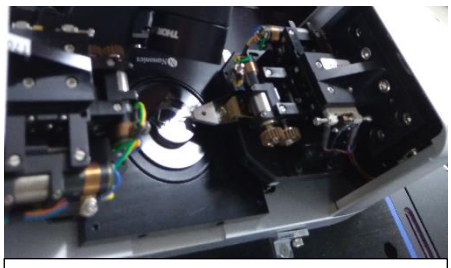
Project:

Manufacturing of innovative materials for the renewable energies or the plasmonic devices is mainly oriented towards nanostructuring. Within this framework, thermal and electronic characterizations should use experimental methods with access to nanometric dimensions and short time scales (around 100fs).

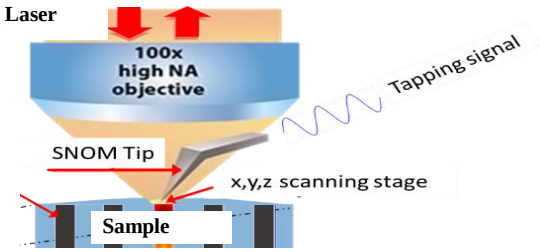
To date, on the one hand, the thermal characterization with a femtosecond resolution scale uses a TDTR (Time Domain ThermoReflectance) setup based on femtosecond lasers[1]. However, the diffraction limit binds the minimum probed area close to 1µm. On the second hand, the nanometric dimension is reached by the use of a device like the AFM (Atomic Force Microscope) [2]. Nevertheless, accessible frequencies may not exceed 1MHz (microsecond time scale).

In the team "Ultra Fast & Nano Scale Energy Transfer", we currently develop a new apparatus based on a SNOM (scanning near-field optical microscope) in which we inject a focused femtosecond laser beam that comes from our TDTR setup. In this configuration, the SNOM's tip positionned inside the focused laser on the sample acts as a spatial sampler. Consequently, the spatial resolution is at least less than 100 nm, and the temporal resolution is maintained around 100fs.



The SNOM seen from the top

During this internship, the student will participate in the instrumental development of this new apparatus. Several characterizations (detection limit, improvement of the spatial resolution …) should be performed. Furthermore, he will tackle the physics principles of the interaction between the SNOM's tip, the laser beam and the sample.



Combination of a SNOM and a TDTR technique

[1] S. Dilhaire, G. Pernot, G. Calbris, J.M. Rampnoux and S. Grauby, Journal of Applied Physics, vol. 110, 114314 (2011).

[2] E. Puyoo, S. Grauby, J-M. Rampnoux, E. Rouvière, S. Dilhaire, Journal of Applied Physics, vol. 109, 024302 (2011).