Laboratoire Hubert Curien
UMR ▪ CNRS ▪ 5516 ▪ Saint-Étienne

PhD position within the Laser-Matter interaction team

Super resolved hybrid laser processing using ultrafast irradiation and chemical etching

Duration: 36 months

Location: Saint-Etienne, France

Expected start date: September 2026

Description

Recent advances in ultrafast laser technology are propelling the development of highly efficient material processing techniques that combine high optical quality with utmost precision through direct laser writing. This capability, responding to challenges in nanofabrication, could unlock new physical and chemical processes by enabling the structuring of materials at the nanoscale, well beyond the classical diffraction limit. These novel functionalities can either enhance inherent surface properties—such as optical performance, wettability, or biological surface interactions—or give rise to entirely new features engineered down to the quantum scale. In this framework, we propose a Ph.D. thesis aimed at developing a novel and innovative laser processing methodology capable of overcoming fundamental physical limitations such as the optical diffraction limit and uncontrolled thermal diffusion phenomena, while resulting in surface features at optical quality. Specifically, we introduce a hybrid nanostructuring approach based on ultrashort-pulse laser irradiation, inspired by the STED (Stimulated Emission Depletion) microscopy technique, extending its principle of super-resolved spatial confinement to the domain of ultrafast laser–matter interaction. The method involves coupling the spatial selectivity of color center generation and annealing by laser beams with chemical etching , enabling nanoscale structuring with controlled aspect ratios for the fabrication of optical metasurfaces. This synergy will introduce a new degree of freedom in defining both the dimensions and morphology of laser-inscribed structures, reaching unprecedented resolution.

Requirements

We are looking for candidates who meet the following criteria:

- MSc degree or equivalent in applied/experimental physics and/or related areas
- Analytic and experimental skills proven by MSc-work or work experience
- Background in optics, nonlinear optics, material science and/or solid state physics
- Ability to develop a software infrastructure for data acquisition and processing
- Motivation and strong interest in laser-matter interaction and laser material processing
- Knowledge of the English language (oral and writing) and communications skills

The following additions would be a great asset:

- Expertise in glasses, defects and in ultrafast spectroscopy
- Knowledge of laser physics and optical alignments
- Programming experience

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The Hubert Curien Laboratory and the Laser-Matter interaction team

The Hubert Curien Laboratory is a Joint Research Unit (UMR 5516) of the National Center for Scientific Research - CNRS and the Université Jean Monnet - UJM, located at 18 Rue Professor Benoît Lauras in Saint-Etienne, and administratively attached to the Faculty of Science and Technology of the UJM. The Laser-Matter interaction team of the laboratory has developed a recognized expertise in femtosecond laser processing for surface structuring, tailored laser beams and multiscale modeling of ultrafast dynamics. Additional information can be found on:
https://laboratoirehubertcurien.univ-st-etienne.fr/en/teams/laser-matter-interaction.html

How to apply

Applicants should send the following documents directly to Dr. Vincenzo De Michele (vincenzo.demichele@univ-st-etienne.fr):

- A complete CV;
- A cover letter;
- A copy of a valid ID document (ID card, passport…)
- Recommendation letters

Deadline

Applications will be processed upon receipt, and applicants are encouraged to apply without delay.

Notes:

- Our research facility operating under a “Restricted Area” status, a security clearance for the successful candidate will be required prior to the beginning of his/her contract.. The application will be filed by university services, upon receipt of specific information requested from the successful candidate.
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