LABORATOIRE HUBERT CURIEN
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Postdoc Position

Ultrafast Laser Structuring for Optical Metasurfaces

A postdoctoral position is available for 1 year at Laboratoire Hubert Curien (LabHC) in Saint-Étienne, France. LabHC is jointly run by the CNRS (The French National Center for Scientific Research) and Jean Monnet University (member of University of Lyon).

Objectives*:* The primary objective of this postdoctoral research position is to develop and implement a novel self-adaptive ultrafast laser surface structuring methodology for creating multispectral metamaterials with low detectability across visible and infrared wavelengths. This involves the design, fabrication, in-situ characterization, and optimization of hierarchical surface structures on metallic substrates.

Research program*:* This project aims to achieve multispectral indetectability of metallic surfaces by controlling their absorption and emission properties through ultrafast laser texturing. The core research program includes the following key stages:

1. **Multi-scale Nanostructuring:** Investigating and controlling the formation of hierarchical surface structures on metallic surfaces via direct ultrafast laser irradiation. This will involve exploring the influence of laser parameters (wavelength, intensity, polarization, pulse duration, repetition rate, scanning strategy, inter-pulse distance) on self-organization phenomena and direct writing.
2. **In-situ Characterization:** Developing and implementing in-situ measurement techniques for characterizing the optical properties of the laser-textured surfaces, specifically focusing on absorption in the visible range and emissivity in the infrared range. This may involve integrating spectroscopic and thermal imaging techniques with the laser processing setup.
3. **Adaptive Feedback Loop Development:** Designing and implementing an intelligent adaptive feedback loop that integrates the in-situ characterization data with an optimization algorithm. This algorithm will autonomously adjust the ultrafast laser processing parameters to achieve the desired multispectral optical response. Addressing the challenge of controlling diverse parameter types within this loop is a key aspect.
4. **Metasurface Design and Optimization:** Utilizing the adaptive feedback loop to design and fabricate optimized metamaterials exhibiting low detectability across the visible and infrared spectra. This will involve exploring various hierarchical nanostructuring strategies to decouple absorption and emission properties.
5. **Proof-of-Concept Demonstration:** Demonstrating the performance of the fabricated metamaterials in terms of their multispectral optical properties and evaluating their potential for applications in areas such as solar energy harvesting and infrared detection.

Keywords*: Ultrafast laser, Structuring, Laser processing, Nanofabrication, Metamaterials, Optical Properties, Absorption, Emissivity, Self-Organization, Adaptive Control, Feedback Loop*

Qualifications*:* The ideal candidate must possess a PhD degree in either Optics, or Physics, Materials Science, or a closely related field. Strong experimental skills in laser physics, preferably with experience in ultrafast laser sources and laser-matter interaction, are essential. Experience in surface science, thin film optics, spectroscopy, optical characterization techniques, and data analysis is highly desirable. Familiarity with programming (e.g., Python, Labview, Matlab) and numerical optimization algorithms would be a significant advantage. The candidate should have a strong publication record and excellent communication skills.

Start date: September-November 2025
Salary conditions: monthly net salary 2000-2600€ depending on experience.

How to apply*:* Interested candidate should send a CV and a short cover letter to:
Pr. Jean-Philippe Colombier (Jean.philippe.colombier@univ-st-etienne.fr)
& Dr. Florent Bourquard (florent.bourquard@univ-st-etienne.fr)
Application deadline*:* July 1st, 2025.