



Master's 2nd year internship

Data Generation for Femtosecond Laser Processing in Silicon Engraving

Laboratory: [LP3](#), Campus de Luminy, Marseille 13009, France

Advisors: Alexandros Mouskeftaras – CNRS researcher (alexandros.mouskeftaras@cnrs.fr)

Finance: ~630 €/month (net)

Duration: 6 months with **Flexible Starting Date** (~1st Semester 2025)

Keywords: photonics, microfabrication

Description: Laser-based manufacturing is a well-established technique widely used in microfabrication facilities across various industries. Its applications are numerous, including marking, engraving, drilling, and cutting of a broad range of materials, from metals and semiconductors to plastics, glass and transparent crystals. Femtosecond lasers, in particular, offer distinct advantages due to their inherent processing characteristics, such as low energy per pulse and ultra-short irradiation duration, resulting in superior processing quality. However, the large parameter space for the laser itself (pulse energy, repetition rate, pulse duration etc.) and the writing (scanning speed, number of repetitions, spatial overlap, etc.) make the development of processing solutions highly tedious and time-consuming. Moreover, an equivalently large number of parameters exist in the output such as engraving depth, processing time, and roughness making laser processing a multi-dimensional problem with no analytical predictive solution.

At LP3, we utilize a femtosecond laser-based workstation comparable to those found in commercial systems¹. At the start of the internship, the student will improve the existing setup by implementing laser control within a unique LabVIEW program. The main objective will be to test a large number of processing configurations and characterize the output using optical confocal microscopy. The focus of the internship will be on generating large datasets based on these configurations, which will later be used for optimization purposes. The student's work will provide the essential data for further analysis, while experts in artificial intelligence from Aix-Marseille University will handle the development and testing of the AI algorithms.

To ensure the project remains manageable, the student will work with a clearly defined set of configurations and output parameters, allowing them to generate comprehensive, high-quality datasets. This focused approach will ensure steady progress throughout the internship, while leaving the complex AI-driven optimization to the experts. The starting point will be laser engraving of silicon, a key application in the microelectronics industry.

Acquired Competencies: Laser machining, Data Acquisition and Management, Interfacing & Automation, Optical Metrology

1. Mouskeftaras, A. *et al.* Short-pulse laser-assisted fabrication of a Si-SiO₂ microcooling device. *Micromachines* **12**, (2021).