

MASTER INTERNSHIP POSITION

Proposé par : Emilien Peytavit

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Groupe de Recherche : Photonique THz

Titre : Design and Implementation of a Pump–Probe Setup for Ultrafast Carrier Lifetime Measurement

Context and Motivation:

The IEMN develops advanced terahertz (THz) components and systems, including high-performance emitters and detectors for time-domain spectroscopy (THz-TDS). The operation of such systems relies critically on semiconductor materials with ultrafast carrier dynamics. Fe-doped indium gallium arsenide (InGaAs:Fe) is a promising material combining high resistivity and tunable carrier lifetime, suitable for excitation around 1.55 μm . Achieving sub-picosecond carrier lifetimes is crucial to improve the temporal resolution and bandwidth of THz emitters and detectors.

Internship Objective&Mission:

The goal of this internship is to design, assemble, and validate a femtosecond pump–probe setup for measuring carrier lifetime in ultrafast materials such as InGaAs:Fe by transient transmission spectroscopy. This setup will enable direct observation of carrier relaxation dynamics following optical excitation and provide quantitative insights to guide material optimization for THz applications.

Description of the Work:

The intern will contribute to the following tasks:

- Conduct a literature review on ultrafast pump–probe techniques for semiconductor materials.
- Design the optical layout of the setup (beam splitting, delay line, focusing optics, detection).
- Implement and align the setup using a femtosecond laser source (around 1.55 μm).
- Develop data acquisition and processing routines for sub-picosecond lifetime extraction.
- Perform and analyze measurements on Fe-doped InGaAs samples with varying doping levels.
- Interpret results in collaboration with researchers involved in THz emitter/detector development.

Expected Outcomes:

By the end of the internship, a fully operational pump–probe measurement bench will be available at IEMN, providing a robust platform for ultrafast material characterization. The results will directly contribute to the optimization of Fe-doped InGaAs for THz photoconductive devices and spectroscopy systems.

Expected Profile:

Master 2 or engineering student in optics, photonics, or applied physics.

Knowledge of ultrafast optics, laser systems, or optical spectroscopy desirable.

Experimental skills in optical alignment and data acquisition.

Motivation for laboratory work and interest in ultrafast semiconductor physics and THz technologies

Salary : ~600€/month.

Duration : between 4 and 6 months

Starting date : Feb/Mars 2027

TWO MONTHS DELAY BETWEEN APPLICATION AND INTERNSHIP STARTING (SECURITY CLEARANCE DELAY)