iemn
Institut d'Electronique, de Microélectronique et de Nanotechnologie
UMR CNRS 8520

M2 Internship Offer

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Title : THz wave generation by photomixing of Ytterbium-doped fiber lasers in a Travelling wave photodetector.

Context : A large number of chemical species have absorption lines in the terahertz (THz) frequency range, making it a very interesting spectral range for molecular spectroscopy applied to the study of the earth and the sciences of the universe. One of the most promising broadband THz sources, operating continuously at room temperature, is based on photodetection of the frequency beat generated by the spatial superposition of two infrared lasers. As part of an ANR-funded project, in collaboration with the Institut de Physique de Rennes, a new photomixer architecture has been studied by the IEMN's THz Photonics group in recent years, with the aim of developing a continuous, broadband source with an output power level of the order of 10 mW at 300 GHz and 1 mW at 1 THz. This photomixer is based on a traveling-wave (TW) photoconductor in which the pump optical wave propagates in the same direction as the generated THz wave. For the THz waves generated when the optical wave passes through to interfere constructively, it is necessary for the optical and THz waves to have identical propagation speeds. Until now, the components developed have been optimized for use with lasers operating at 800nm [1].

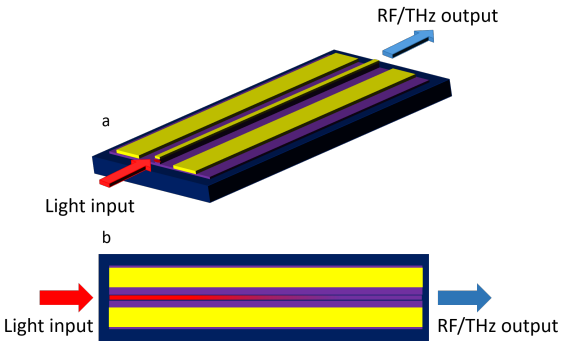

Figure 1 : (a) Schematic representation of a TW-photomixer. (b) Top view of a TW-photomixer showing the absorption of the optical input along the device resulting in the RF/THz generation.

Tasks : The candidate recruited will be responsible for transposing this concept to make it compatible with Ytterbium ion-doped fiber lasers operating around 1um, which offer much higher output powers than lasers available at 800nm.

The design will use SILVACO and/or Lumerical software to optimize the optoelectronic properties of the photomixer, and HFSS and CST Microwave software to study the electromagnetic properties of the THz propagation structure.

Devices fabrication will take place on the MicroNanofabrication platform, which covers 1600m² of clean room space and has a wide range of equipment, from basic semiconductor industry equipment to cutting-edge micro-nanofabrication equipment.

Characterization will be carried out on the THz optoelectronic characterization benches of the Photonics and Optics Microwave Characterization Platform (CHOP).

Given the quantity and diversity of the tasks and themes of the project - semiconductor physics, nanophotonics, electromagnetism, microwave design, microfabrication, optoelectronic and THz characterization - the student's precise work will be discussed on a case-by-case basis and will depend on his or her tastes and abilities.

Expected profile: For this multidisciplinary internship, we're looking for a student with solid background in at least one of the following fields: microelectronics/microtechnology, microwaves, semiconductor devices physics or optoelectronics, and who is motivated by research in applied physics.

Career Opportunities offered by this internship: The trainee will have the opportunity to start a PhD thesis (funding has already been secured). Additionally, they may apply for other doctoral grants or pursue a career in the telecommunications or defense industries focused on semiconductors, optoelectronics, high frequency components, and systems.

Salary : ~600€/month. Duration : between 4 and 6 months Starting date : Mars 2024

[1] F. Bavedila *et al.*, "Development of a millimeter-long Travelling wave THz photomixer," *J. Light. Technol.*, vol. 39, no. 14, pp. 4700–4709, 2021, doi: 10.1109/JLT.2021.3078226.