Université Lille Nord de France
Pôle de Recherche et d'Enseignement Supérieur

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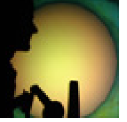

| Titre Thèse | Beam shaping for femtosecond laser micromachining: application to the packaging of mm and THz electronic functions | |
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**Résumé du sujet : Beam shaping for femtosecond laser micromachining: application to the packaging of mm and THz electronic functions**

The most recent developments in the field of telecommunications and ultra-high-speed data transfer have been considerably boosted by the rise of Cloud Storage and Computing and the development of the 5G telecommunications standard. Closely linked to the emergence of Artificial Intelligence (AI), Sensor Networks (IoT), data processing and storage, one of the challenges to be met is the move to data rates above 100 Gb/s. This can only be achieved by developing technologies, components and systems in millimetre (mmW) and sub-TeraHertz (sub-THz) bands. The assembly of systems in this frequency range lies in the gap between i) submicron fabrication technologies that are too expensive and oversized for the fabrication of components with dimensions in the 10-1000 µm range and ii) conventional mechanical machining methods limited by the small size of the structures. In this context, the introduction of a laser micromachining technique, with a resolution in the 1-10 µm range, makes sense within the System-Moore integration paradigm where the packaging is an integral part of the system design. The integration of this work in the technological value chain covers a broad spectrum using STMicroelectronics HF technologies/circuits/components in a strategy of assembly and packaging to create a system function. The target market is that of high-speed telecoms (backhaul infrastructure for point-to-point links) and metrology to characterize and qualify components/circuits based on STMicroelectronics technologies.

The research work associated with this mission will consist in implementing the laser microstructuring technique for the fabrication of functional blocks integrating mmW and sub-THz components such as guides, filters, resonators, diplexers, coplanar-rectangular transitions etc... A first activity will consist in exploring a range of materials with contrasting properties (alumina, polycarbonate, ceramic/polymer composite, PMMA, ...) in order to determine their suitability for laser micromachining in terms of etching speed and anisotropy as well as surface roughness. A second major objective will be to implement a laser beam shaping setup to transform the conventional Gaussian beam into a Top-Hat profile in order to improve the quality of surface micromachining. A third line of research will be devoted to the development of functional packages for the packaging of highly integrated active probes for the measurement of silicon components in G (140-220 GHz) and J (220-325 GHz) bands.

This subject widely implements the use of laser micromachining techniques in the context of LEAF Equipex project ( https://www.youtube.com/watch?v=9uCjtT7uX40&feature=youtu.be )