PhD position on Graphene Nanostructures for THz laser emission

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Scientific Project: The terahertz (THz) frequency domain (typically 0.1 to 10 THz) is a very specific region within the electromagnetic spectrum, which lies between the microwave and mid-infrared ranges. THz radiation has many promising applications in various areas of science and technology such as astronomy, chemistry, bio-security and high bandwidth communications. However, even if THz rays are being widely studied, their consumer applications are almost inexistent due to the lack of compact powerful sources. Thus, the development of a coherent, miniature and powerful source of THz radiation that can operate at room temperature is one of the main challenges of modern THz technology.

Our group is currently exploring the potential of graphene to generate coherent THz radiation*[1]*. Indeed, owing to its unique properties such as a band structure with a zero-energy gap, THz photons can instigate interband transitions at THz frequencies, suggesting that THz lasing may be possible*[2]*.

The aim of this thesis is to investigate the potential of graphene nanostructures for the realization of novel THz lasers. The candidate will characterize the optical properties of graphene nanostructures at THz frequencies using time-domain spectroscopy experiment. The candidate will study the influence of the morphology of these graphene nanostructures (size, shape,..) on the optical transitions and their selection rules. The candidate will then perform optical pump-THz probe experiments to investigate the carrier relaxation dynamics in these graphene nanostructures. Microscopic models will be developed to interpret the experimental results. He/She will establish a formulism between the graphene nanostructure morphology and their optical response and carrier dynamics. The candidate will also perform gain measurements in these graphene-based nanostructures. The objective is to design graphene nanostructures with long lifetime optical gain at THz frequencies by reducing non-radiative recombination channels.

The thesis will be full time and will start in September or October 2019 and funded by an ERC Consolidator project. The salary will be the standard CNRS PhD salary.

[1] J. Maysonnave, S. Huppert, F. Wang, S. Maero, C. Berger, W. de Heer, W; T.B. Norris, L. A. De Vaulchier, S. Dhillon, J. Tignon, R. Ferreira, J. Mangeney, Nano Lett. ***14****, 5797 (2014)*
[2] S. Massabeau, M. Baillergeau, T. Phuphachong, C. Berger, W. A. de Heer, S. Dhillon, J. Tignon, L. A. de Vaulchier, R. Ferreira, and J. Mangeney, Phys. Rev. B ***95****, 085311 (2017)*

Applicant profile required: Skills in optical and electronical properties of condensed matter

Applications must include a detailed CV; references (people who may be contacted); a cover letter; available marks records for the Masters 1 and 2 or the engineering degrees.

Contact for more information:

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