ZINC OXIDE BASED QUANTUM HETEROSTRUCTURES : A NOVEL PLATFORM FOR OPTOELECTRONC DEVICES FROM UV TO THZ?

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As a wide band gap semiconductor, ZnO have attracted much attention due to the opportunity of combining band gap engineering, with large excitonic binding energies in the UV-visible range. While many wonderful fundamental results (LED, polariton lasers, etc) have been obtained with this material platform thanks a huge improvement of the growth methods, the development has always been limited in terms of applications by a lack of reliable p-type doping.

In this presentation I will address new opportunities of this material platform in a radically different range which does not require p-type doping: from IR to THz.

In the infrared range, Quantum Cascade Lasers are very efficient and already commercialized. Now lots of effort are made to shift to THz due to the numerous potential applications linked to this wavelength domain. But the operation temperature is still limited in the THz range due to an intrinsic limitation of the material systems used (III-V compounds). In this presentation we will show that wurtzite oxides could be good candidates for this application.

After a deep optimization of the designs and the growth processes1, quantum cascade detectors and emitters have been processed and characterized in the Mid-IR2 and the THz range3 demonstrating the huge potential of oxides to address the issue of efficient emitters in the THz range at room temperature.

In addition, I will also present new opportunities of these heterostructures in more fundamental fields such as hyperbolic metamaterials4 and multisubband plasmons5.

1 N. Le Biavan, et al., Applied Physics Letters 111 (2017).
2 A. Jollivet, et al., Applied Physics Letters 113 (2018).
3 B. Meng, et al., ACS Photonics 8, 343 (2021).
4 A. Hierro, et al., Physical Review Letters 123, 117401 (2019).
5 M. M. Bajo, et al., Physical Review Applied 10 (2018).