

Doctoral positions 2019

Thesis supervisor

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Thesis topic : **Toward electrically pumped laser diode from nanocrystal**

Nanocrystals are semiconductor nanoparticles with size tunable optical features thanks to quantum confinement. For the last 5 years they are integrated in the last generation of LCD display as green and red light source. Currently the TV relies on a blue LED made of InGaN quantum well which is optically pumping the nanocrystal. Beyond this first mass market application, quantum dots raises a lots of interest as single photon source, as well as for lasing [1] and LED [2]. Here the long term perspective is to go toward the electrically pumped laser using nanocrystal as active media

Current quantum dots based Led face a major issue, their light extraction is poor. Indeed when light emission is isotropic, total reflexion within the diode substrate make that only 20% of the light can be extracted. Here we aim to design a new generation of LED with optimized light extraction. To do so we will use anisotropic emitter and more specifically 2D colloidal nanocrystal [3]. Thanks to their anisotropic emission, we can obtain enhanced light extraction.



Luminescence obtained from nanocrystals in the visible range



A second aspect of the project relates to the investigation of the stimulated emission from this nanoparticle. Compared to spherical nanocrystal, the 2D nanoplatelets have been found to have a much lower threshold for lasing. We aim to investigate this property. Here the student will have in charge to build a time resolved and spectrally resolved amplified stimulated emission.

Possibly, we will by the end of the thesis try to expand the setup up to the short wave infrared [5]

The project is quite pluridisciplinary with both fabrication transport and spectroscopy aspect. The project will be conducted in collaboration with ESPCI (S. Ithurria team) and a PME company which will be in charge to provide us the nanoplatelets

Highly motivated students are welcome to apply. Only a basic semiconductor background is necessary. However labview programming and spectroscopy skills can be a plus

References

- [1] V. Klimov et al, Science 290, 314 (2000)
- [2] J. Lim et al, Nature Mat. 17, 42 (2018)
- [3] E. Lhuillier et al, Accounts for chemical research 22, 48 (2015).
- [4] N. Goubet et al, Nano Lett 18, 4590 (2018)
- [5] P. Geiregat, Nat Mat 17, 35 (2017)

Type of thesis: experimental,

Sources of funding available: european and industrial funding are already obtained for highly motivated student