

## Near-field optical microscopy and spectroscopy on quantum cascade laser

### *Subject*

The near-field optics activities at ESPCI are mainly devoted to scattering-type scanning near field optical microscopy (SNOM). Our recent studies have been devoted thermal radiation scanning tunnelling microscopy [1] and to the observation of the near-field at the surface of infrared (IR) quantum cascade lasers (QCLs) [2] and to terahertz (THz) imaging [3] beyond the diffraction limit. The maximum scanning range of the SNOM images which is currently achievable in the laboratory is of the order of 100 micrometers, which is in many cases not sufficient for these studies. The postdoctoral position that we propose is focused on the investigation of the spatial distribution of all the modes which are confined inside the cavity of QCLs, or on the observation of surface plasmons produced from QCLs. The stationary wave pattern observed in SNOM images inside the cavity of QCLs will be analysed and compared to their emission spectra. These studies will require the design and fabrication of a new SNOM with a large scanning range (typically 1 mm). The new setup will also provide the possibility to probe THz near-fields produced at the surface of optically non-linear crystals, or at the surface of THz QCLs, although this would require integration inside a cryostat.

The project is mainly focused on experimentation, as it implies the set-up of a new scanning probe which should eventually be integrated inside a cryostat. The postdoctoral candidate should have a strong expertise in scanning probe microscopy (for instance AFM, STM, SNOM, etc. ). Good knowledge in instrumentation, in optics or near-field optics, and in solid state physics is also desired. Experience in the field of optical measurements and some knowledge in data and image processing are pertinent. Due to the strong experimental aspect of the project, our main requirement is that the candidate should have high skills and interest in experimentation, and enjoy the making of new experimental setups.

[1] *Thermal Radiation Scanning Tunnelling Microscopy*, Y. De Wilde, F. Formanek, R. Carminati, B. Gralak, P.-A. Lemoine, J.-P. Mulet, K. Joulain, Y. Chen, J.-J. Greffet, *Nature* **444**, 740 (2006).

[2] *Direct imaging of a laser mode via mid-infrared near-field microscopy*  
V. Moreau, P.-A. Lemoine, M. Bahriz, Y. De Wilde, R. Colombelli, L. Wilson, A. B. Krysa, *Applied Physics Letters*, **90**, 201114 (2007).

[3] *THz emission Microscopy with sub-wavelength broadband source*  
R. Lecaque, S. Grésillon, C Boccara  
*Optics Express* (2008) accepted.

*Application deadline* 19th March 2008

*Job starting* October 2008 at the latest

*Contract* 1 year

*Gross salary* 30000 €

*Funding* through CNRS

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