

NANOFTIR

SPECTROSCOPIE A TRANSFORMEE DE FOURIER RESOLUE SPATIALEMENT A L'ECHELLE DE 100 NANOMETRES

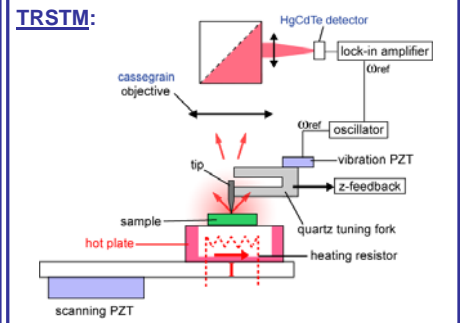
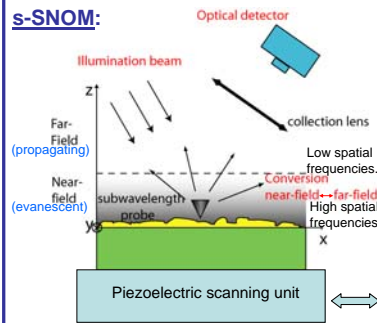
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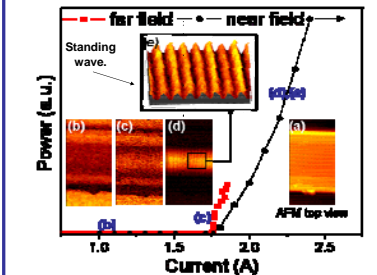
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Introduction:

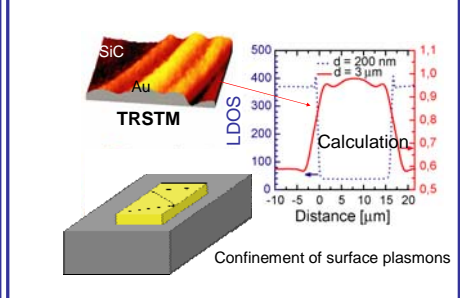
- Scattering-type scanning near-field optical microscopy (s-SNOM) provides the ability to achieve a resolution $\ll \lambda$.
- We have produced a s-SNOM which operates in the mid-infrared. Two results had been obtained before starting the project:
- Measurements of the thermal radiation in the near-field \rightarrow spatial mapping of the local electromagnetic density of states (EM-LDOS) with a thermal radiation scanning tunnelling microscope (TRSTM) [1].
- Measurements of the near-field on quantum cascade lasers with air confinement \rightarrow intra-cavity images of the modes [2].



s-SNOM images of quantum cascade lasers with air confinement [2]:



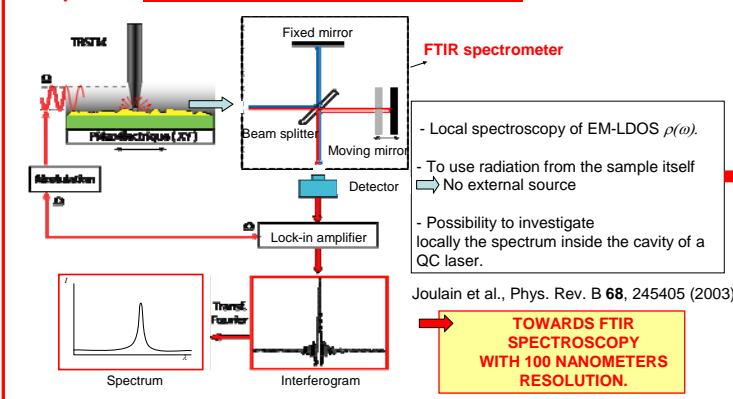
TRSTM images vs. EM-LDOS [1]:



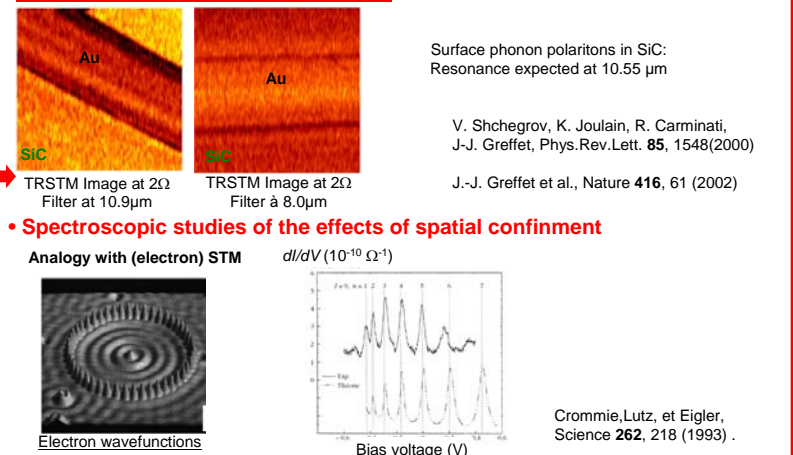
Motivations:

- Combination a s-SNOM with a Fourier Transform Infrared Spectrometer (FTIR) in order:
 - (1) to break the diffraction limit in FTIR spectroscopy
 - (2) to analyze the energy dependence of the EM-LDOS
- Near-field imaging and spectroscopy of new types of quantum cascade lasers based on surface plasmonics.

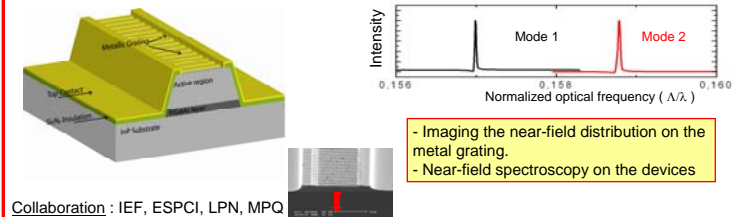
Prospect 1 : Coupling TRSTM – FTIR spectrometer:



Local probing of surface resonances:



Prospect 2 : Investigation QCLs with a metal grating:



Current status :

- A FTIR spectrometer has been purchased (ESPCI)
- QC lasers with metal grating are being developed (IEF)
- Theoretical modeling of the TRSTM signal (LET)

References: [1] De Wilde, Formanek, Carminati, Gralak, Lemoine, Mulet, Joulain, Chen, Greffet, Nature **444**, 740 (2006).
 [2] Moreau, Bahriz, Colombelli, Lemoine, De Wilde, Wilson, Krysa, Applied Physics Letters **90**, 201114 (2007)