08.00-10.00 JFA - Joint Symposium: Near Field Optical Microscopy Techniques
Presider: D. Courjon, *P.M. Duffieux Université de Franche Comte, Besancon, FRANCE* **LOMOND**

08.00 JFA1 (Invited)

Near Field Optics, Light Microscopy At The Molecular Scale

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Through many technological advances during the last decade near-field scanning optical microscopy (NSOM) has gradually established its position as a light microscopic technique featuring: true optical contrast, 50 nm resolution, low background, single molecule sensitivity, nanometric topographic resolution through build-in force microscopy and a wide range of applications [1].

This presentation will discuss recent achievements using NSOM:

- Probe fabrication and efficiency [2]: using laser heated fibre pulling, fast Al coating and ion beam milling NSOM probes are reproducibly fabricated with apertures down to 20 nm, throughput 10-5 and circular symmetric polarisation behaviour.
- Tuning fork technology for shear force detection [3]: Implementation of tuning forks and phase feedback for distance control has resulted in high speed shear force imaging with 0.05 nm vertical noise. Single molecules such as DNA and proteins are visualised in topography.
- Single molecular detection [4]: Single fluorescent molecules are imaged with 70 nm FWHM, giving a position accuracy of 1 nm. The orientation of the emission dipole of all molecules in one image is determined by detection in two perpendicular polarisation directions. Thus lateral and rotational mobility is followed over hours with ms resolution.
- Single molecule photo-dynamics: On/off switching of single molecular fluorescence is observed, with dark intervals varying from 0.1 ms to many seconds. Short intervals are attributed to inter system crossing to the non-emitting triplet state (lifetime ~0.4ms).
- Single DNA - dye - protein detection [5,6]: Co-localisation of individual fluorophores at specific sites on DNA with DNA topography.
- Detection of individual green fluorescent proteins.
- Photon tunnelling microscopy of guided fields: Nanometer scale imaging of the distribution of electro-magnetic fields in integrated optical waveguides, such as mode splitters.

[1] Moers MHP, Kalle W, Ruiter AGT, Raap A, Greve J, de Grooth BG & van Hulst NF. Fluorescence In Situ Hybridisation on Metaphase Chromosomes observed by near-field microscopy, J.Microscopy 1996;182:40-45.

[2] Veerman JA,Otter AMB, Kuipers L & van Hulst NF, Improved near field optical aperture probes fabricated by focussed ion beam. Appl. Phys. Lett. 1998;72 in print.

[3] Ruiter AGT, Veerman JA, v/d Werf KO & van Hulst NF, Dynamic behaviour of tuning fork shear force feedback. Appl. Phys. Lett. 1997;71:28-30.

[4] Ruiter AGT, Veerman JA, Garcia-Parajo MF & van Hulst NF. Single molecule rotational and translational diffusion observed by NSOM. J.Phys.Chem.A 1997;101:7318-7323

[5] van Hulst NF, Garcia-Parajo MF, Moers MHP, Veerman JA & Ruiter AGT. Near-field fluorescence imaging of genetic material: toward the molecular limit J.Structural Biol. 1997;119:222-231.

[6] Garcia-Parajo MF, Veerman JA, van Noort SJT, de Grooth BG, Greve J & van Hulst NF. Near-field optical microscopy of DNA-dye interaction at the single molecular level. Bioimaging 1998; 6, 43-53.

08.30 JFA2 (Invited)

Optical Properties at Nanometric Scale Using a Metallic Probe

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We have developed an approach to near-field optics taking advantage of a metallic nano-antenna which scatter efficiently the local field on a sample surface. The resolution is about 5 nm regardless of the wavelength. Applications in the visible and IR will be described.