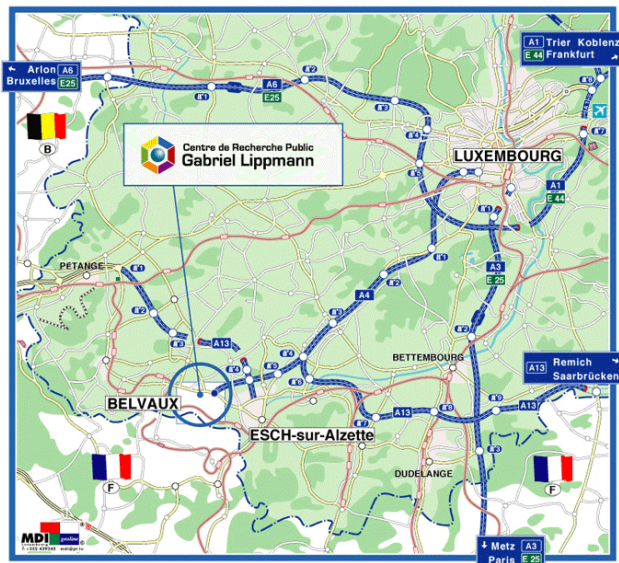


High-performance tools for the investigation of cells, biological and vegetal tissues

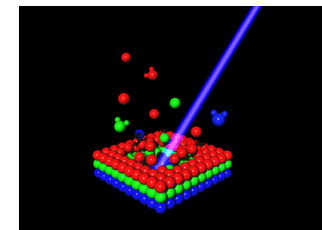
Department Science and Analysis of Materials



Dr J-Nicolas AUDINOT

Materials Dept 60 persons

Environment Dept. 120 persons



- **Materials Characterization**

All materials, surface, thin film, bulk and particles

- **Surface and Interface Analysis**

Elemental and molecular chemistry in these regions at ppb levels

- **Multi-Element Depth Profiling**

At depth of nm to tens of μm

- **Elemental and Molecular Imaging**

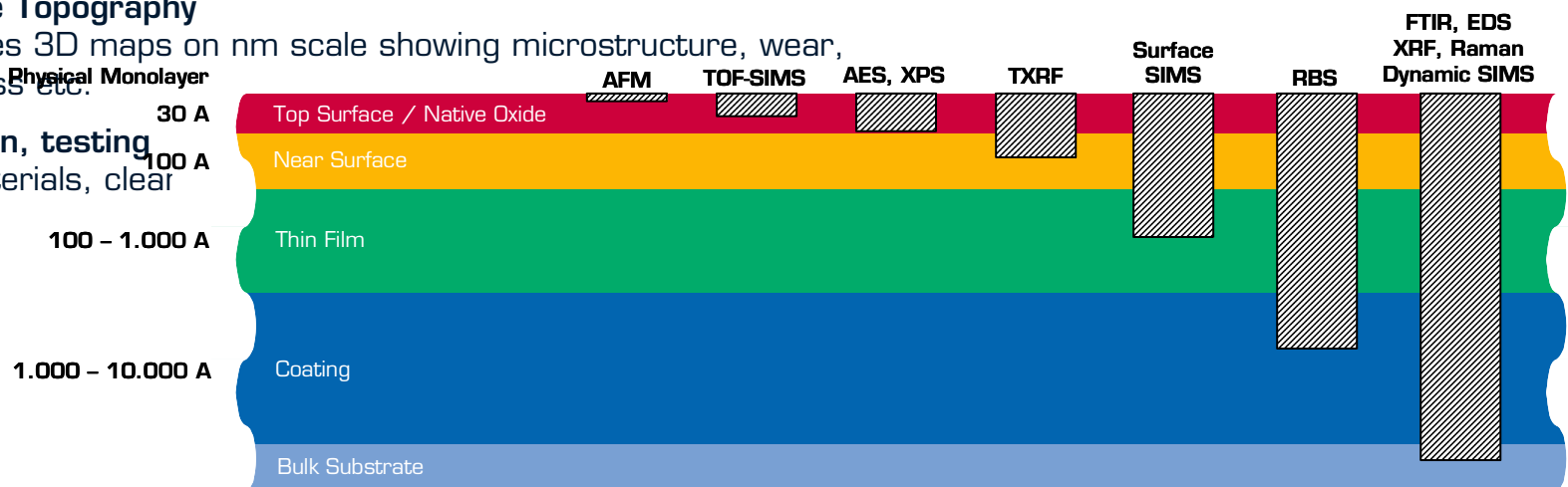
Maps the entire chemistry across a surface or cross-section

- **Surface Topography**

Generates 3D maps on nm scale showing microstructure, wear, roughness etc.

- **Validation, testing**

Raw materials, clear



Research projects :

- industrials and academics partners

- competitive project

Service activity

-



- Secondary Ion Mass Spectrometry in Dynamic Mode (5 D-SIMS instruments)
- Secondary Ion Mass Spectrometry in Static Mode (ToF-SIMS)
- Scanning Probe Microscopy SPM (AFM, EFM, MFM)
- Scanning Electron Microscopy (SEM)
- Transmission Electron Microscopy (TEM)
- Auger Electron Spectrometry (AES)
- Fourier Transform Infrared Spectroscopy (FTIR)
- X-Ray Diffractometry (XRD)
- X-Ray Photoelectron Spectroscopy (XPS, ESCA)
- Metallography (chemical etching; optical microscopy)



Previous FP6, Network of excellence

European PhD School on

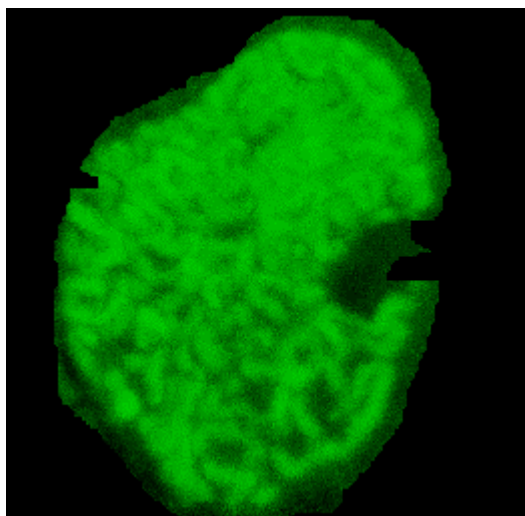
“NANOANALYSIS USING FINELY FOCUSED ION AND ELECTRON BEAMS”

BELVAUX, Luxembourg
November 16th - 20th 2009

PhD school

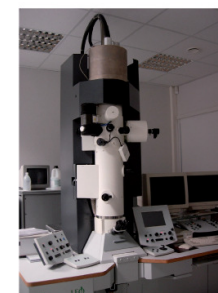
No registration fees

Grant possible



“TEACHING WEEK 1: SECONDARY ION MASS SPECTROMETRY (SIMS), TRANSMISSION ELECTRON MICROSCOPY (TEM), AUGER ELECTRON SPECTROSCOPY (AES): A COMPREHENSIVE OVERVIEW”

- > Ion and electron - matter interactions
- > Instrumentation
- > Applications



The PhD School organized by the NANOBREAMS Network of Excellence focuses on SIMS, TEM and AES. It consists of four “teaching weeks” and one “analysis week” composing a two year cycle:

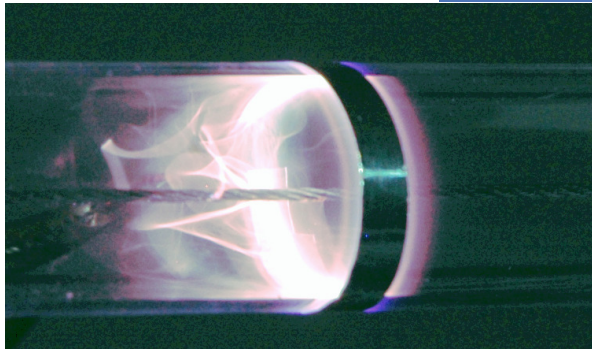
- > Each “teaching week” proposes theoretical tutorials and practical sessions.
 - The week 1 provides an overview of the three techniques
 - The weeks 2, 3 and 4 aim at forming specialists in the field
- > The “analysis week” permits the attendees to analyze their own samples of interest.

REGISTRATION

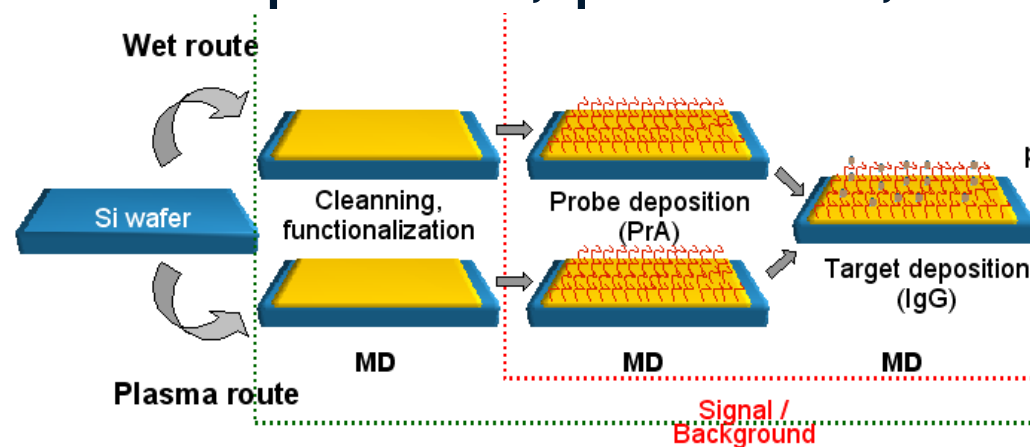
No registration fees
Application deadline: 9th November 2009
Audience: scientists with a degree in physics, biology and materials science
60 attendees maximum
Teaching program and application: www.nanobeams.org
More information: phd-school@lippmann.lu, tel: +352 470261 317

Our activities regarding the Cost action

- - Surface treatment
- - Toxicology
- - Instrumentation, modification

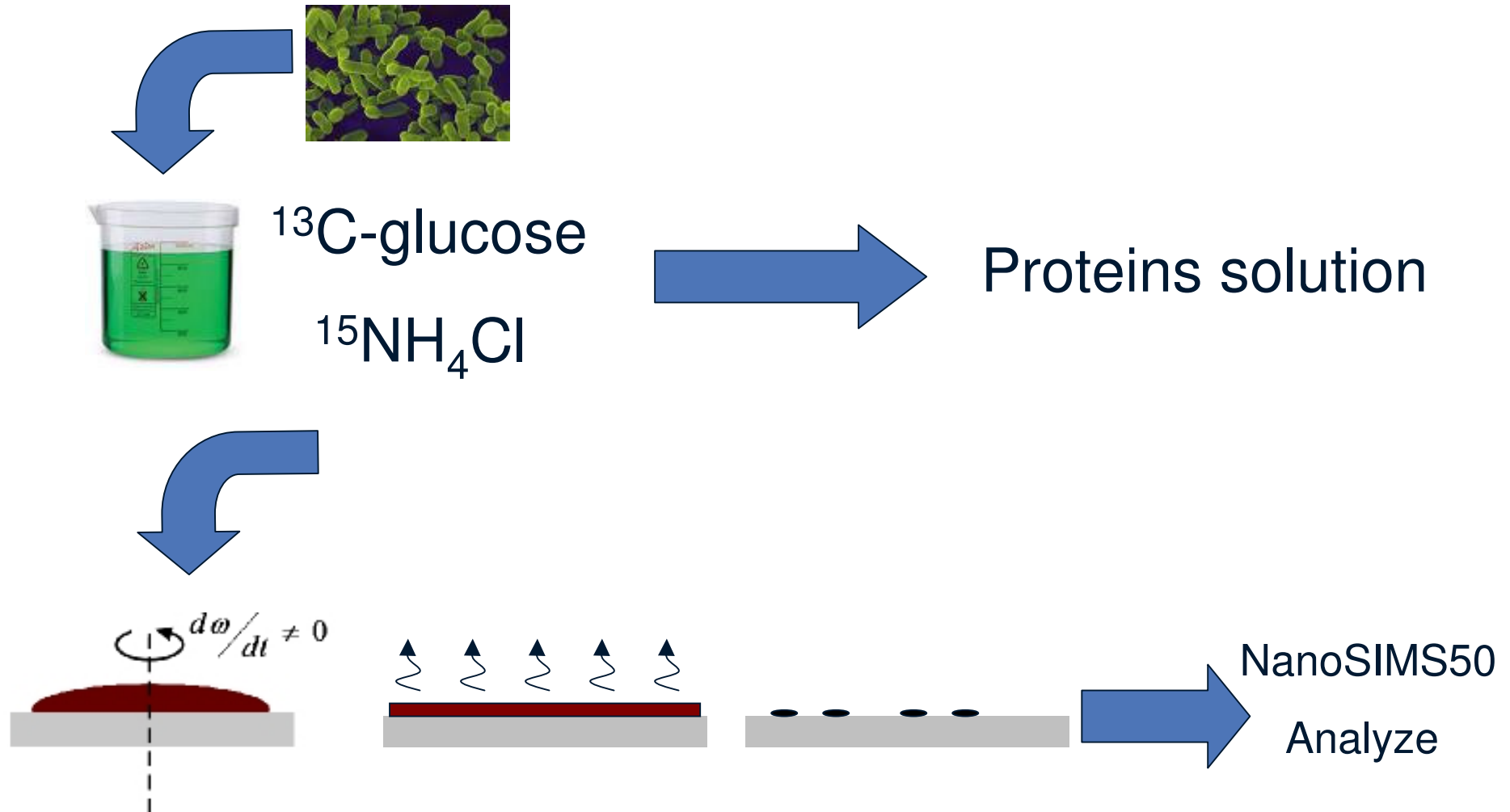


- Surface functionalization
- → fixation probes, proteins,



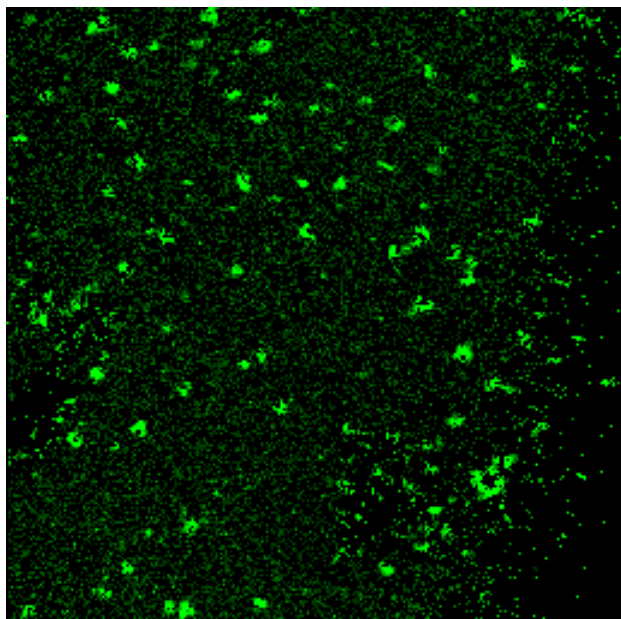
•Surface treatment

Detection of single protein



>2 cts

$$\text{Reconstructed image} = \frac{{}^{13}\text{C}{}^{15}\text{N}}{({}^{13}\text{C}{}^{15}\text{N} + {}^{12}\text{C}{}^{14}\text{N})}$$



Average counts $2 \cdot 10^{-2}$ for 15 230 pixels
(normal $4 \cdot 10^{-5}$)

Isotopic measurement possible

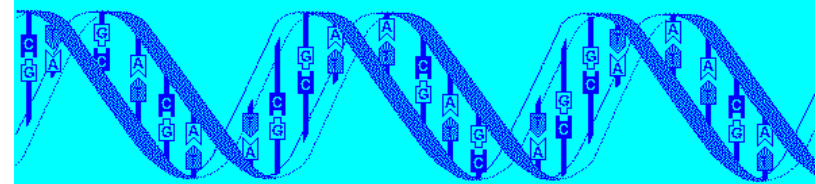
10 x 10 μm^2 10 ms/pixels

Applied Surface Science 2010

coll. INRA, IMN, Genomic Vision

Monnier-Batto, Coffinier, Jannière, Bensimon

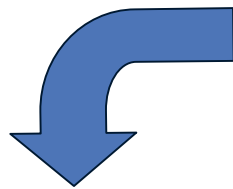
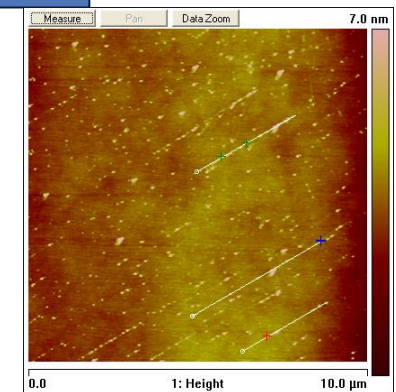
Substitution of amino acids



AFM

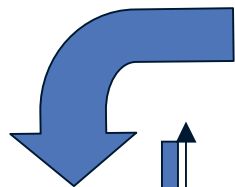


2.3 kb/ μm

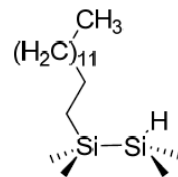


^{13}C -glucose

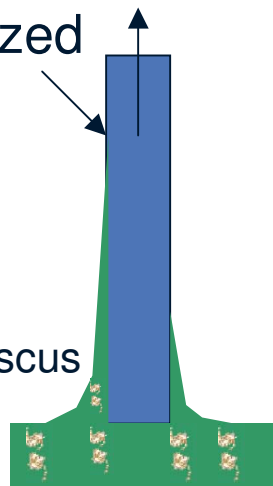
$^{15}\text{NH}_4\text{Cl}$

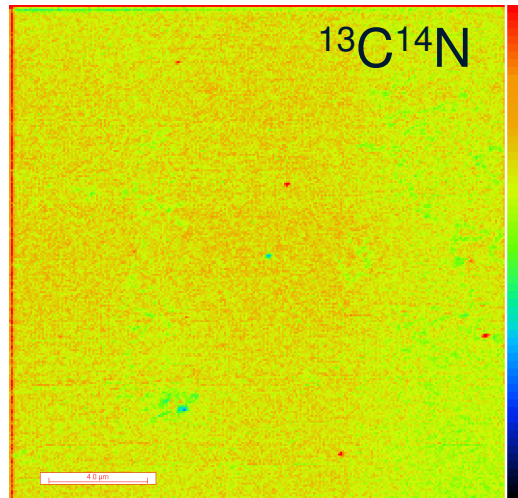


Si functionalized



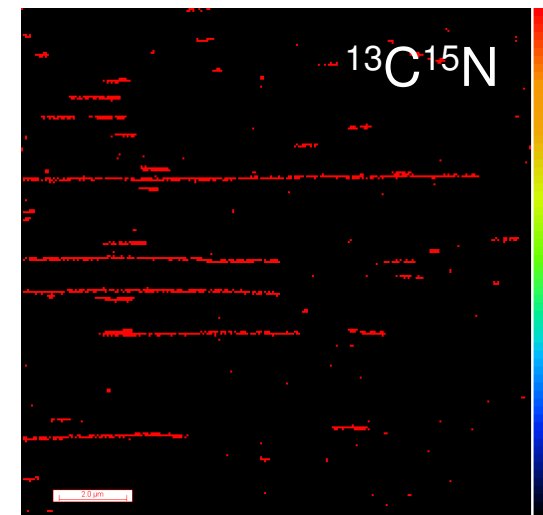
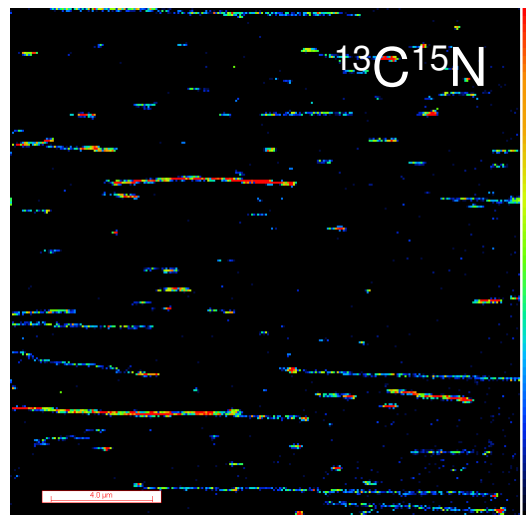
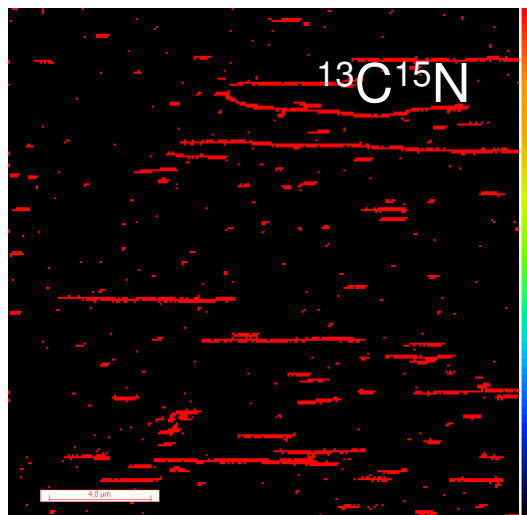
meniscus



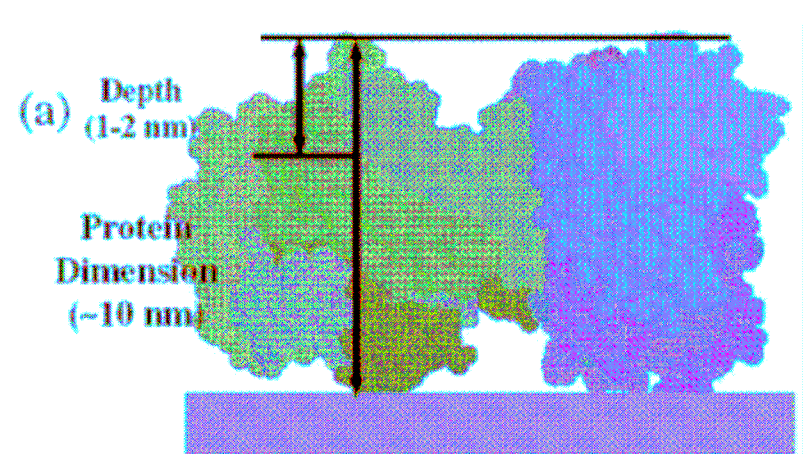


Analysis with Cs^0
deposition

Diameter of DNA fiber : 22 \AA

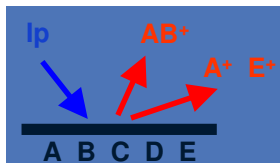


- We can provide specific surfaces
- Question : Characterization of “ bio sensor”, target fixationchallenge ?

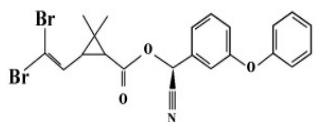


- A major activity of our center
- → study of Nps effect on environment





Mapping the exposure of Br containing pesticide to *Daphnia*



deltamethrin, a bromine containing pesticide

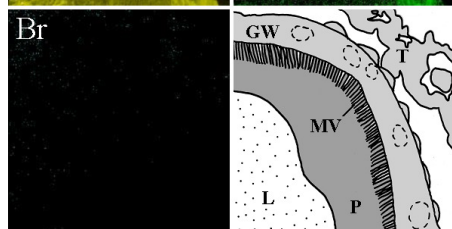
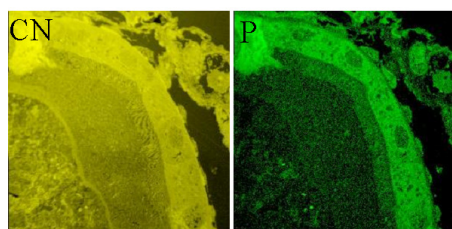
Col. CRPGL/EVA

T. Eybe

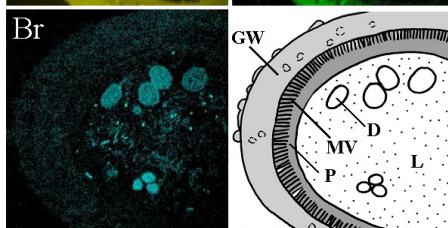
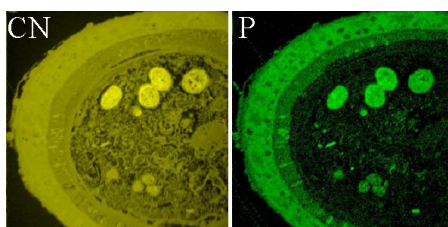
T. Bohn

A. Gutleb

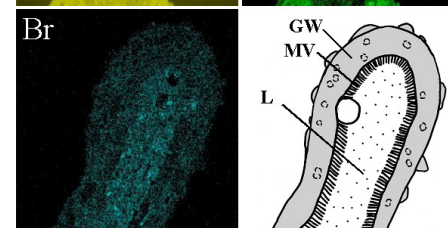
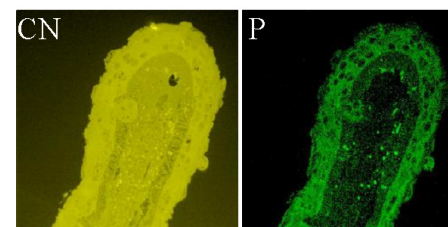
L. Hoffmann



Gut from *Daphnia magna* (control) after 48 h



Gut from *Daphnia magna* (exposed to 0.1 μM deltamethrin for 48h)

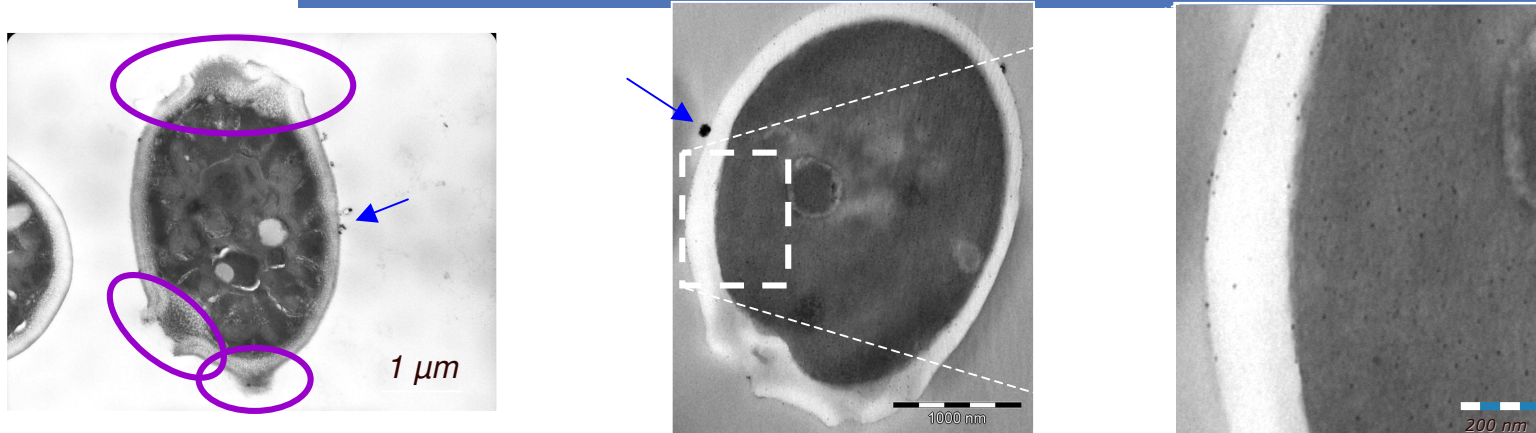


Gut from *Daphnia magna* (exposed to 0.4 μM deltamethrin for 48 h)

Picture legend: D: *Desmodesmus subspicatus*, GW: gut wall, L: lumen with food particles, MV: microvilli layer, P: peritrophic membrane, T: tissue remains.

Published in Chemosphere, Microbiology,..

Elemental analysis of *Saccharomyces cerevisiae* after contact with different surfaces (Ag, FeO, Nps,)

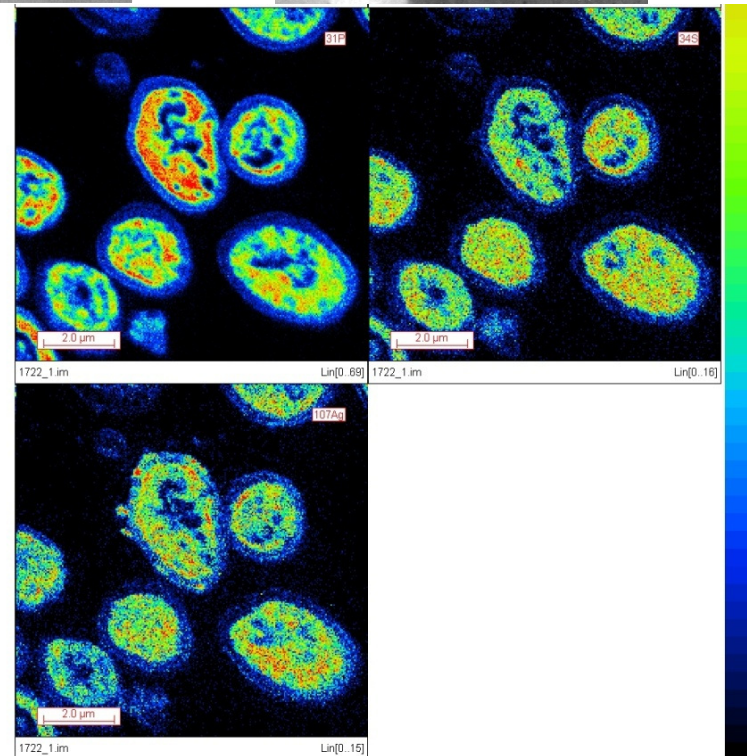
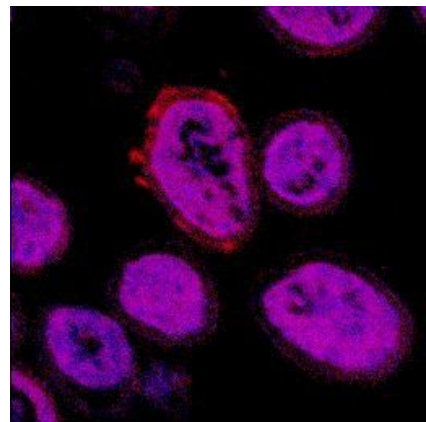


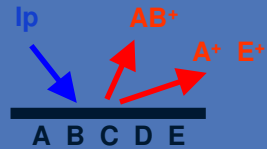
Yeast cell after a 24 h-contact with a nanosilver-containing coating (Ag = 20.5% at.) in saline solution (NaCl 0,15 M)

Overlap of ^{107}Ag image (red) and ^{34}S image (blue)
=> pink

Col. LISBP Toulouse

Submitted



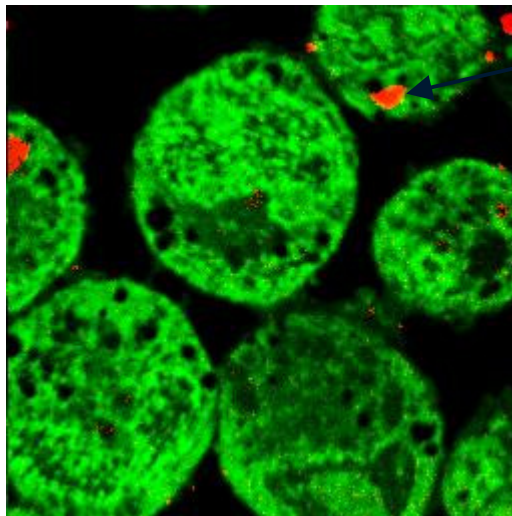
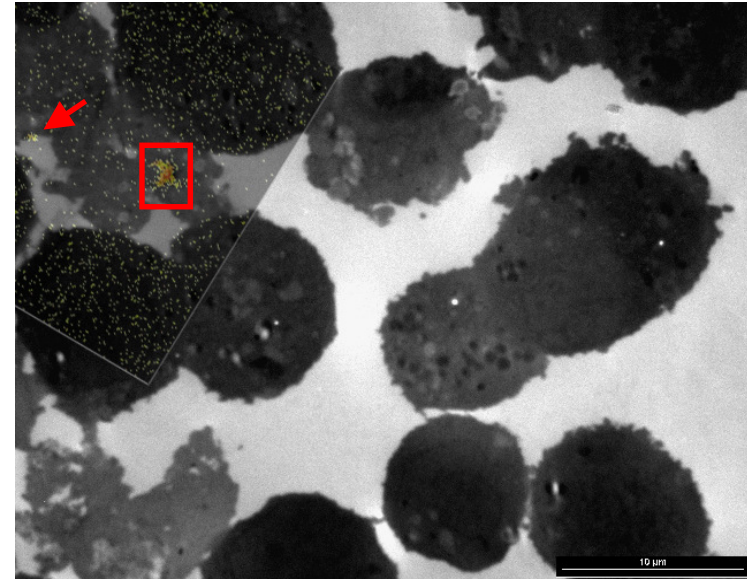


Copper localization in Cell

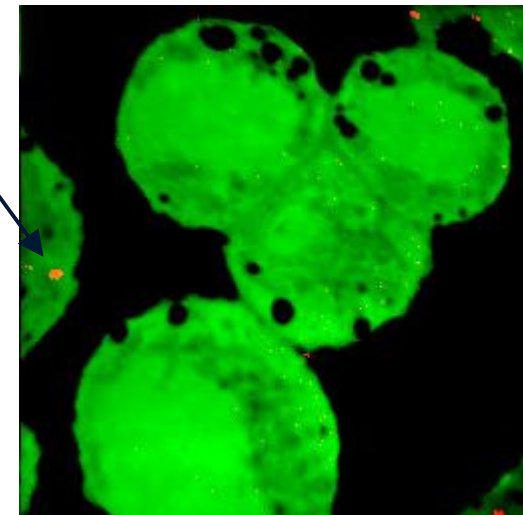
TEM +SIMS

Unité de Recherche en Biologie Cellulaire (URBC)
Nanotoxico, Namur

To be published

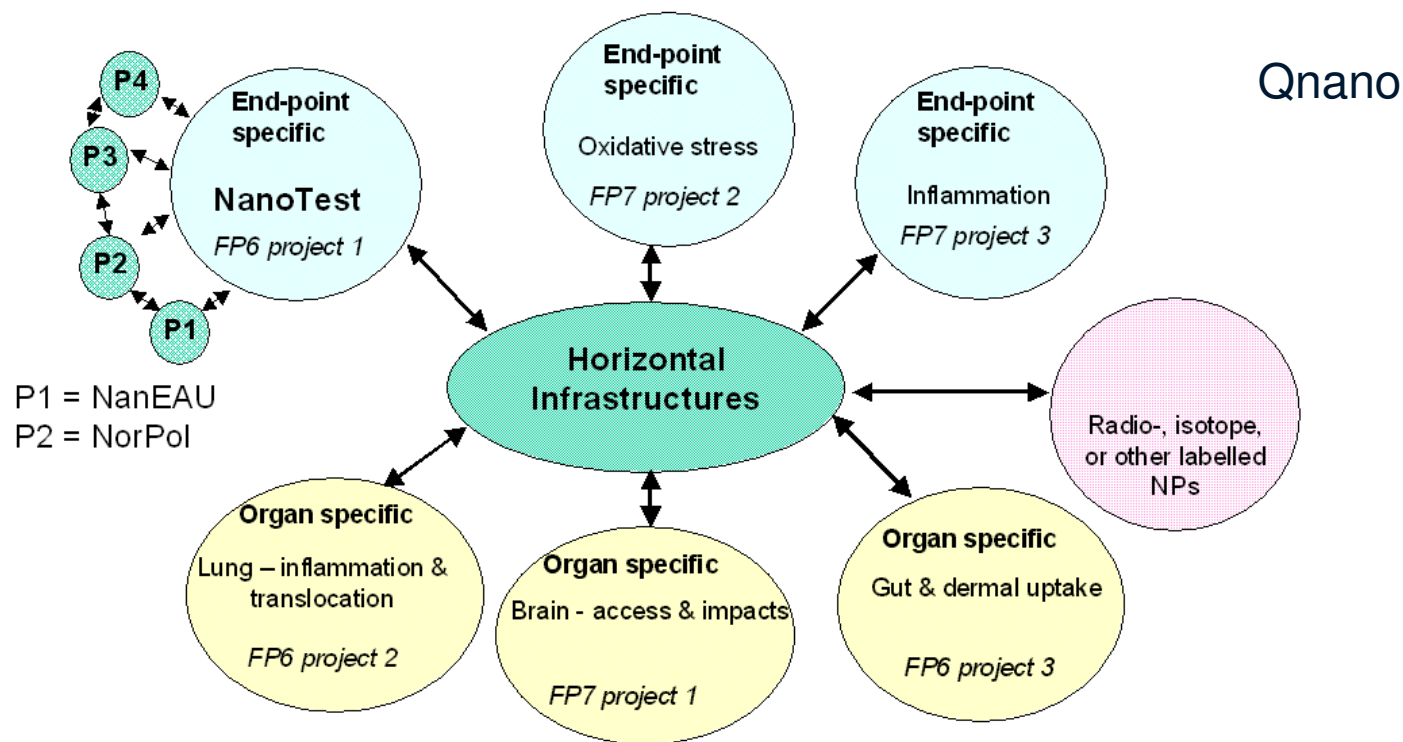


Cu



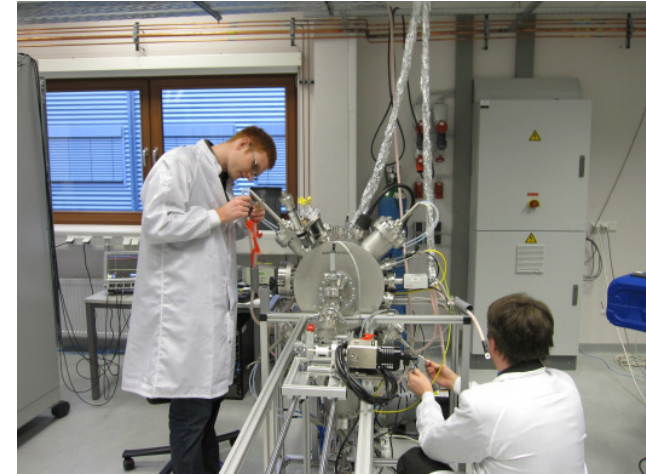
Green, CN (protein, amino acid, ..)

We are involved in many European toxicology projects

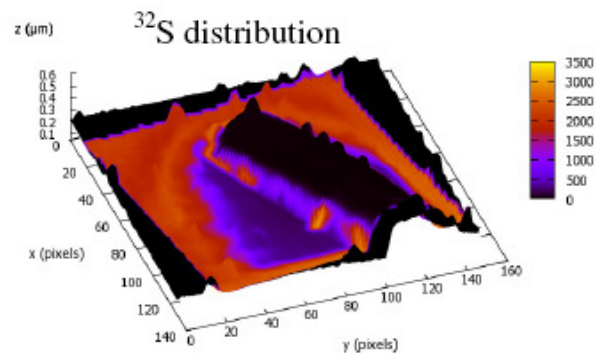
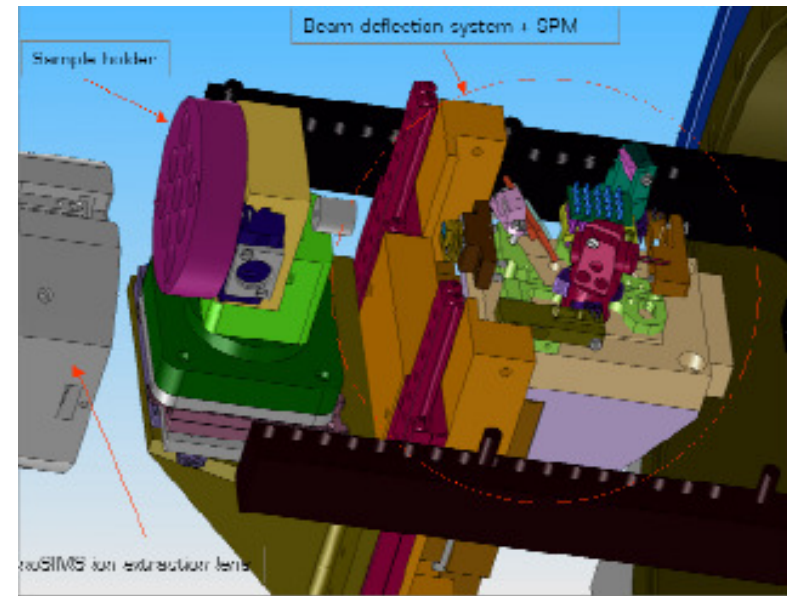


- Increase the performance of commercial instruments
- → new field of application

- → Development of instrument will be fully automated, “ push button type “



Installation of AFM in a UHV instrument



New software

Study of membrane AFM+
MS, Science 2008, Kraft et al.

News applications

