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
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

PhD school
No registration fees
Grant possible

European PhD School on

"NANOANALYSIS USING FINELY FOCUSED ION AND ELECTRON BEAMS"

BELVAUX, Luxembourg
November 18th - 20th 2009

"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 NANOBEAMS 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 students 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
90 attendees maximum
Teaching program and application: www.nanobeams.org
More information: phd-school@lippmann.lu, tel. +352 4702811 317

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Our activities regarding the Cost action

- Surface treatment
- Toxicology
- Instrumentation, modification
• Surface functionalization
• → fixation probes, proteins, ……
Surface treatment

Detection of single protein

13C-glucose

15NH₄Cl

Proteins solution

NanoSIMS50

Analyze

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Detection of single protein

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

Average counts $2.10^{-2}$ for 15 230 pixels
(normal $4.10^{-5}$)

Isotopic measurement possible

10 x10 µm$^2$ 10 ms/pixels

Applied Surface Science 2010
Detection of single protein

coll. INRA, IMN, Genomic Vision
Monnier-Batto, Coffinier, Jannière, Bensimon

Substitution of amino acids

13C-glucose

15NH4Cl

Si functionalized

AFM

2.3 kb/µm

meniscus

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Detection of single protein

Analysis with Cs$^0$ deposition

Diameter of DNA fiber: 22 Å
• We can provide specifics surfaces

• Question : Characterization of “bio sensor”, target fixation ….challenge ?
• 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

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

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

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


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

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

To be published
We are involved in many European toxicology projects
*Instrumentation*

- 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

News applications ....