Nanoscale characterization

Tuesday March 18th

3:15 P.M. - 6:45 P.M.

ROOM AB

Program of the session :

Chairs: P1 Céline ELIE-CAILLE
P2 Séverine GOMEZ et Guillaume COLAS

HOUR	NAME	TITLE
15:15	Brice GAUTIER JNL - INSA	Présentation du GDR Carmanano
15:30	**Myriam TAVERNA Inst. Galien Paris - Univ. Paris Saclay**	**Advancing Extracellular Vesicle Characterization with Capillary Electrophoresis**
16:00	James BEHAN ISCR - CNRS	Characterisation of Biogenic Nanomaterials Produced by Electroactive Bacteria using Differential Centrifugal Sedimentation
16:15	Lisa ROYER InProcess-LSP	Non-invasive and sterile nanoparticle size measurement in a broad range of containers using spatially resolved dynamic light scattering
17:00	Matias FELDMAN INSP - Sorbonne. Univ	Nanoscale control of heat flux in self-assembled ordered nanocrystal solids
17:15	François HENN L2C - Université de Montpellier	Engineering Individual SWCNT Nanofluidic Device for Enhanced Signal-to-Noise Ratio
17:30	Florant EXERTIER GPM - CNRS	Atomic scale microscopy of different materials by ultrashort THz-driven Atom Probe Tomography
17:45	Francois TREUSSART LuMIn - ENS Paris-Saclay	Polarization texture and sensing application of ferroelectric nanocrystals
18:00	Max GERIN ESRF	High pressure study of exotic hexagonal phase of Ge grown by molecular beam epitaxy on self-assisted GaAs nanowires

Myriam TAVERNA (Univ. Paris Saclay - Inst. Galien Paris-Saclay, Orsay)

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Short biography

Myriam Taverna was appointed full professor in analytical chemistry and pharmaceutical biotechnology in 2005 and senior member at the Institut Universitaire de France (IUF) in 2017. She is currently the director of the Institut Galien Paris-Saclay (IGPS-CNRS) at the university of Paris-Saclay, a CNRS-research unit composed of 6 teams. She is the head of one team strongly dedicated to analytical developments with a focus on miniaturized techniques (including microsystems, biosensors and capillary electrophoresis) for the analysis of peptides, (glyco)proteins being biopharmaceuticals, drug targets or disease biomarkers. She is particularly recognized for her expertise in capillary 190 international scientific papers, a dozen of international chapters. She is a member of the editorial board of Analytica Chimica Acta. Her research work in the field of biomarkers of Alzheimer's disease, led her to co-found in 2014 the start-up Alzohis. She started exploring extracellular vesicles and in particular new miniaturized techniques to characterize them in depth in 2018. Recently her research focuses on the exploration of Extracellular vesicles for diagnostic and therapeutic applications.

Advancing Extracellular Vesicle Characterization with Capillary Electrophoresis

Extracellular vesicles (EVs) have recently emerged as a source of prognostic or diagnostic molecular biomarkers. Their isolation and enrichment from biological fluids remains however a challenging prerequisite prior to their exploration. To provide sufficient physical and biological information on the isolated EVs, many complementary techniques have to be carried out (e.g. microscopy-based methods, DLS, NTA, TRPS, or flow cytometry...) (1). Although some of them offer indisputable advantages, there is a great need for new techniques allowing accurate detection and characterization of EVs, in suspension, over their entire size range, with minimal calibration requirements and the ability to distinguish EV subtypes or to discriminate them from non-EV contaminants.

Over the last few years, our team has developed innovative analytical techniques for the detection and characterisation of EVs (2), most of which exploit capillary electrophoresis (CE) by using its various separation modes or the technique's ability to perform electrokinetic preconcentrations to obtain either better resolution between subpopulations or improved sensitivity for detecting EVs.

In this talk the different investigated CE-separation modes (capillary zone electrophoresis, isoelectric focusing) for characterizing EVs isolated from bovine milk or animal plasma will be presented as well as their advantages, limits and the kind of information they provide (3,4)
We have also explored Taylor dispersion analysis (TDA) conducted using CE as an alternative technique to assess the size and purity of EVs. We provided recently the first proof of concept of TDA applicability to this kind of bio-nanoparticles (5). The coupling of two separation modes into a 2D configuration (unpublished data) or of an electrokinetic preconcentration (isotachophoresis) (6) allowed us also recently to push forward the sensitivity limits of the technique for EVs.

Keywords

Characterization, capillary electrophoresis, isoelectric focusing, Taylor dispersion analysis, extracellular vesicles

Acknowledgement

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References

1-Alexandre L., Sun J. Taverna M, Zhong W., Anal Bioanal Chem; Advances in extracellular vesicles analysis (2023) 415(7):1235.
2-M. Morani, T.D. Mai, et al. Recent electrokinetic strategies for isolation, enrichment and separation of extracellular vesicles, Trends Anal. Chem. 135 (2021) 116179.
3- M. Morani, T.D. Mai, Z. Krupova, et al. Electrokinetic characterization of extracellular vesicles with capillary electrophoresis: A new tool for their identification and quantification, Anal Chim Acta 1128 (2020) 42.
4- D. Zohouri et al, Talanta (submitted) (2025)
5- Obeid S, Chamieh J, Mai TD, Morani M, et al. Fast, simple and calibration-free size characterization and quality control of extracellular vesicles using capillary Taylor dispersion analysis, J Chromatogr A. (2023), 705:46418
6-D. Zohouri, M. Taverna, et al. Investigation of on-line electrokinetic enrichment strategies for capillary electrophoresis of extracellular vesicles, J. Chromatogr. A 1730 (2024) 465116

Nanoscale characterization

Thursday March 20th

10:30 A.M. - 12:30 A.M.

ROOM CD

Program of the session :

Chairs: Brice GAUTIER et Rosine COQ GERMANICUS

HOUR	NAME	TITLE
10:30	**François PIQUEMAL**	**ELENA project – electrical nanoscale metrology in industry: Review of the main results**
11:00	Jose MORAN LNE	Calibrated measurements of dopant concentration on vertical nanowires by scanning microwave microscopy
11:15	José ALVAREZ GeePS - CNRS	Understanding and Optimizing Local Electrical Measurements on Cross-Sectional devices Using Conductive Atomic Force Microscopy (C-AFM)
11:30	Hugues GIRARD NIMBE - CEA	In situ photoemission spectroscopies to reveal surface transfer doping on hydrogenated milled nanodiamonds
11:45	Emma AOUSTIN Lab. Albert Fert - CNRS	Towards switchable magnetic tunnel junctions based on polyoxometalates monolayer.
12:00	Anthony SZYMCZYK ISCR - Rennes	Electrokinetic Leakage: Danger and Opportunity for Advanced Materials Characterization
12:15	Bertrand BOUDART GREYC - Univ. Caen Normandie	Time-resolved self-heating temperature measurements of GaN-based HEMTs using nanoparticles as Raman thermometers

François PIQUEMAL (LNE, Trappes)

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Short biography

Francois Piquemal received the PhD degree in condensed matter physics from the Université de Jussieu, Paris (1988) and the habilitation degree in Sciences for Engineer from the Ecole Normale Supérieure ENS-Cachan (2013). He has more than 30 years of experience in fundamental and quantum electrical metrology. His current research interests include the electrical metrology at the nanoscale based on scanning probe microscopy, in particular Scanning Microwave Microscopy (SMM) and Conductive probe Atomic Force Microscopy (C-AFM).

ELENA project – electrical nanoscale metrology in industry: Review of the main results

The measurement of electrical properties at the nanoscale allows evaluating the performance of nanomaterials developed for consumer electronics, innovative quantum technologies, and IoT applications. Local DC resistances and high frequency (HF) impedances are among the most prominent properties to measure for nowadays-advanced devices. Currently, Conductive probe Atomic Force Microscopy (C-AFM) and Scanning Microwave Microscopy (SMM) are two main techniques used for the characterization of these properties. Although powerful, these two techniques suffer from major drawbacks: costly, complicated implementation, and lack of traceability. Measurements are thus unreliable.

The European project ELENA (1st September 2021 - 31st August 2024) was aimed at pioneering the traceability of such measurements, with stated uncertainties (targeting in the order of 10% or less), increasing the affordability of these methods by developing and testing cost effective instrumentation and reference standards spanning the range from DC to GHz. Elaboration of robust calibration methods and good practice guides using simplified uncertainty budgets was planned to underpin this effort. This required the quantification of uncertainty contributions due to influencing factors (samples design, tip-sample interactions, measurement's instrument in the laboratory environment) and the development of reliable 3D multi-physics models to evaluate in particular the effect of the water meniscus (at the tip-sample interface) as well as the effects of the tip's real shape and composition on electrical measurements. We will review the key results obtained in this project and give some perspectives.

Keywords

Calibration methods, conductive probe AFM, metrology, reference standards, scanning microwave microscopy

Acknowledgement

The project (EMPIR 20IND12 ELENA) has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.The project (EMPIR 20IND12 ELENA) has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.

References

Elena Project website: http://projects.lne.eu/jrp-elena/

Poster Session

FUNCTIONAL THIN FILMS, NANOSTRUCTURES & 2D MATERIALS/ NANOSCALE CHARACTERIZATION

N° POSTER	TITLE	NOM	Prénom
64	OVERCOMING SAMPLE PREPARATION CHALLENGES IN NANOPARTICLE CHARACTERIZATION BY SEM	AMBERT	Stéphane
65	THE HREELM Project – The High Resolution Electron Energy Loss Microscope is coming to probe the surface vibrations at the microscopic scale	AMIAUD	Lionel
66	Development of measuring protocols and data processing methods for reference samples designed to calibrate electrical measurements at nanoscale	CHRETIEN/PIQUEMAL/HOUZE/MORAN-MEZA/HAROURI	Pascal/François/Frédéric/josé/Abdelmounaim
67	AI-Machine Learning models for conductive electrical modes on AFM: maps prediction and material clustering	COQ GERMANICUS	Rosine
68	Unravelling complex mixtures at the nanoscale: the power of coupling field flow fractionation and electron microscopy (FFF-EM)	CROUZIER	Loïc
69	Boron Phosphide Nanocrystals from the Viewpoint of Pair Distribution Function Analysis	DOISNEAU	Clara
70	Combined Study of Casimir-Polder Interactions and Patch Potentials on SiNx Nanogratings	FABRE	Nathalie
71	Nano-architecture of mixed organic layers on a silver surface	GUAN	Yimin
72	CARBON NANOTUBE MECHANICAL MASS SENSOR WITH SUB-YOCTOGRAM SENSITIVITY AT ROOM TEMPERATURE	HENN	François
73	Nanoscale characterization of ZnS:Cu Phosphor Powder	HERNANDEZ	Roberto
74	Fluorescence properties of mixed-dimension heterostructures	LE BALLE	Juliette
75	In-rich InGaN/GaN nanowires for red light emitting diodes	TCHOULAYEU POSSIE	Nidel Dilan
76	Design of efficient nanocatalysts for H2 release from boranes and silanes	THIBAULT	Maxime
77	THE HREELM Project – The High Resolution Electron Energy Loss Microscope is coming to probe the surface vibrations at the microscopic scale	AMIAUD	Lionel
78	Enhanced Light Absorption through Nanostructuring of Titanium Nitride (TiN)	BEN MOUSSA	Nizar
79	Study of physical properties of antiphase boundaries in III-V epitaxial layer on silicon with conductive tip atomic force microscopy (C-AFM) and with Kelvin Probe Force Microscopy (KPFM) techniques.	BERNARD	Rozenn
80	Interfacial self-assembly of polydiacetylene and graphene oxide for organic photovoltaics	BISTINTZANOS	Alexia
81	TMD Engineering of 2D-Magnetic Tunnel Junctions – From Barriers to Electrodes	DANIEL	Jane
82	Study and Characterization of TzDA Langmuir Films for Polydiacetylene-Based Sensors	KANDYLI	Maria
83	Charge transfer between plasmonic PdAg nanoparticles and C60 molecules	LI	Xingtong
84	Développement et caractérisation de cristaux magnoniques sur substrats flexibles pour la straintronique	MNASRI	Walid
85	Direct CVD graphene integration for Spintronics	PERRIN	Jérémy
86	Design and Synthesis of Bioactive Materials Using Two-Photon Polymerization and Thiol-Ene Click Chemistry	PINON VASQUEZ	Ana Karen
87	Engineering Spin Wave dispersion and Surface Acoustic Wave-driven FMR in Fe thin films by N-implantation	SHARMA	Anupam