JMCS8 - 2025

Eight Journée Systèmes & Matière Complexes

November 14, 2025

Gif-sur-Yvette, France

Service de Physique de l'État Condensé (SPEC)

INSTITUT INTÉGRATIF DES MATÉRIAUX | université PARIS-SACLAY

spec | cea | université PARIS-SACLAY GRADUATE SCHOOL Physique | PhOM Physique des Ondes et de la Matière

Contents

Introduction

The eight Journée Systèmes & Matière Complexes (JSMC8) will be held at the SPEC-Amphi Bloch on Novembre 14, 2025. The meeting's objective is to provide the opportunity for UPSaclay's research scientists to showcase their works and network around the complex system's theme in 2IM – Theme 2 and PHOM:

- disordered systems
- complex fluids
- complex dynamics
- statistical approaches
- multi-scale materials
- biological systems

This will be the eighth time the event will be hosted on the Plateau de Saclay. Specifically, previous editions were held at CEA Orme des Merisiers on November 7, 2016, ENS Cachan on November 30, 2017, Ecole Centrale Supélec on November 23, 2018, Institut Pascal on October 14, 2019, Covid edition online November 16, 2020, ENS Paris-Saclay October 04, 2021 and LPS Faculté des sciences d'Orsay October 16, 2023.

Organizing committee

The meeting is organized by the Institut Intégratif des Matériaux (2IM) - Theme 2 board members:

Carine Douarche	UPSaclay, ORSAY, FAST
Cindy Rountree	CEA, IRAMIS, SPEC, SPHYNX
David Simeone	CEA, DES, SRMA, LA2M
Antoine Thill	CEA, IRAMIS, NIMBE, LIONS

Program - JSMC8-2025

08:30 - 08:45	Registration		
08:45 - 09:00	Opening Remarks		
09:00 - 09:40	Stefania CACOVICH	IPVF	Multimodal Photoluminescence Imaging in Photovoltaic Material Analysis
09:40 - 10:40	Session A: Short Presentations		
10:40 - 11:00	Coffee Break		
11:00 - 11:40	Guillaume ZANTE	DRF, IRAMIS, NIMBE, LICSEN	AI-assisted sorting of electronic waste enabling improved chemical recycling of critical and precious metals
11:40 - 12:40	Session B: Short Presentations		
12:40 - 14:00	Lunch Break		
14:00 - 14:40	Laurence RAMOS	University Montpellier, L2C	Catching Enzymes in Action
14:40 - 15:40	Session C: Short Presentations		
15:40 - 16:00	Coffee Break		
16:00 - 16:40	Philippe THOMAS	CNRS - IPP	A two-parameter nucleation model for the condensation of Lennard-Jones particles
16:40 - 18:00	Session D: Short Presentations		

Abstracts

Multimodal Photoluminescence Imaging in Photovoltaic Material Analysis

Stefania CACOVICH

IPVF, France

TBD

AI-assisted sorting of electronic waste enabling improved chemical recycling of critical and precious metals

Guillaume ZANTE

DRF, IRAMIS, NIMBE, LICSEN

Electronic waste is the fastest growing source of waste, with more than 17 kg/capita generated in Europe, of which less than 50% is properly documented, collected, and recycled [1]. Recycling strategies involve to shred the waste and recover metals through high-temperature (pyrometallurgy) and/or chemical processing using aqueous solutions (hydrometallurgy). Most recyclers focus on highly concentrated (copper, aluminium, etc) or highly valuable metals (precious and platinum group metals). Recycling rates of the critical metals (neodymium, tantalum, niobium) found in waste printed circuit boards (PCBs) are generally lower than 10% [2]. Despite their importance to the economy and their high supply risk, concentration of those metals in electronic waste is too low to ensure economic viability of their recovery from such a complex stream. The alternative approach developed at CEA Saclay involves dismantling PCBs to recover electrical components, the latter being enriched in critical metals (Nd in multi-layer capacitors, Ta and Nb in capacitors, etc). 90% of the components can be sorted by machine vision with an accuracy as high as 97.5% by training a convolutional neural network on a database containing images of components [3]. The remaining 10% of components have a similar appearance but a different chemical composition. This fraction can be sorted by elemental composition using multi-energy X-ray transmission. The obtained hyperspectral image is treated to identify target elements and their specific k-edge energy. An overall accuracy of 97% was obtained, allowing to concentrate the metals with enrichment factors as high as 10,000. This approach also facilitates the downstream processing to recover metals with high recovery rates, high purities and low environmental footprint through simple hydrometallurgical steps. High purity (>99%) and high-yield (>90%) neodymium recovery was achieved with a simple dissolution- precipitation strategy [4]. Similar results were obtained for tantalum recovery from capacitors or elemental gold recovery from wire-bonded micro-controllers, which was demonstrated at the kg-scale. In this presentation, we will describe the sorting tool and give examples of tailored hydrometallurgical process aimed at critical and precious metals recovery from e-waste.

References

1. C.P. Baldé, R. Kuehr, T. Yamamoto, R. McDonald, E. D'Angelo, S. Althaf, G. Bel, O. Deubzer, E. Fernandez-Cubillo, V. Forti, V. Gray, S. Herat, S. Honda, G. Iattoni, V.L. di Cortemiglia, Y. Lobuntsova, I. Nnorom, N. Pralat, M. Wagner, The Global E-Waste Monitor 2024, (2024).
2. DocsRoom - European Commission, (n.d.). https://ec.europa.eu/docsroom/documents/27348 (accessed July 21, 2025).
3. N.M. Charpentier, A.A. Maurice, D. Xia, W.-J. Li, C.-S. Chua, A. Brambilla, J.-C.P. Gabriel, Urban mining of unexploited spent critical metals from E-waste made possible using advanced sorting, Resources, Conservation and Recycling 196 (2023) 107033. https://doi.org/10.1016/j.resconrec.2023.107033.
4. D. Xia, N.M. Charpentier, A.A. Maurice, A. Brambilla, Q. Yan, J.-C.P. Gabriel, Sustainable route for Nd recycling from waste electronic components featured with unique element-specific sorting enabling simplified hydrometallurgy, Chemical Engineering Journal 441 (2022) 135886. https://doi.org/10.1016/j.cej.2022.135886.

Catching Enzymes in Action

Laurence RAMOS[a]
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The propagation mechanisms of enzymes in the substrates they degrade is an interdisciplinary topic of current debate, involving complex diffusion in crowded environments, polymer physics and enzymology. Besides, the understanding of the enzymatic degradation of hemicellulose is of utmost importance for a sustainable production of fuels and bioplastics from plant biomass. We investigate the enzymatic degradation of solutions and gels of arabinoxylan (AX), one of the most abundant polysaccharides of plant hemicellulose, by means of an original optical setup which combines Fluorescence Imaging and Photon Correlation Imaging (PCI), a multispeckle Dynamic Light Scattering technique allowing one to probe the spatio-temporal heterogeneous dynamics of colloidal and polymer systems. Thanks to this setup, the time-evolution of the spatial distribution of the fluorescently-labelled enzyme and the microscopic dynamics of the polymer matrix undergoing degradation are measured simultaneously. In this talk, I will present our technique and our first sets of experimental results and analysis.

A two-parameter nucleation model for the condensation of Lennard-Jones particles

Philippe THOMAS

IPVF, France

While very popular for its ability to provide an elegant conceptual framework, classical nucleation theory often fails at quantitatively reproducing most of the experimental and numerical observations of first order transitions. In this talk, we extend CNT by explicitly incorporating the multi-dimensional aspect of nucleation. Focusing on the liquid condensation of a Lennard-Jones gas, we used state of the art rare event sampling simulations to precisely characterize the nucleation event emphasizing the specific features of the critical cluster. Our numerical results indicate a simultaneous growth and densification in liquid condensation. We then exploit these insights to develop a 2-variable nucleation theory. Our model based on the capillary approximation is able to quantitatively retrieve the numerical results in nucleation rate and critical cluster properties. Furthermore, our model provides a qualitatively more accurate representation of nucleation near the spinodal regime. The effectiveness of this integrated numerical and theoretical framework highlights the limitations of CNT and more recent theories while offering a robust foundation for its refinement.

Useful Information

Talks will be held at the **Amphi Bloch** at Orme de Merisiers on the Campus of the CEA-Saclay research center in Gif-sur-Yvette. It is situated on the ground floor to the left of the main entrance of building 772.

To get there from Paris or Charles de Gaulle airport take the RER B subway to the stop 'Le Guichet' and then bus 9. Please ask the driver to stop a the Orme de Merisier.

Coffee breaks will be offered in the main entrance hall.

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