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NanoSIMS Cryo

Unlock native chemistry at the nanoscale

NanoSIMS Cryo

The NanoSIMS Cryo accessory extends the capabilities of the NanoSIMS-HR by enabling analysis of samples in their native frozen-hydrated state. By preserving structural and chemical integrity throughout cryogenic sample preparation and transfer, NanoSIMS Cryo enables elemental and isotopic imaging under conditions that closely reflect the original state of the specimen.

For life science applications, biological samples can be analyzed without the dilution and redistribution artefacts often associated with conventional resin-embedding workflows. For soft materials research, NanoSIMS Cryo preserves native morphology and composition, enabling the investigation of elemental and isotopic distributions while maintaining structural integrity.

Fully integrated into the cryogenic workflow—from sample preparation and transfer to NanoSIMS-HR analysis—NanoSIMS Cryo combines high spatial resolution, high mass resolution, and high sensitivity under cryogenic conditions. Scientists can investigate complex processes with greater confidence, extending the reach of nanoanalysis into previously inaccessible application domains.

What the NanoSIMS Cryo Delivers

- Image samples in their native frozen-hydrated state
- Reveal the true-to-life distribution of signaling elements at subcellular level
- Preserve pristine distribution of isotopes and elements in soft material
- Avoid dilution and redistribution artifacts associated with resin embedding

Why Cryo Matters

- Optimize food formulations and improve the shelf life of cosmetic products
- Reveal cellular functions and mechanisms for fundamental biology and pathology understanding

Seamless Cryogenic Workflow

NanoSIMS Cryo integrates seamlessly with Leica cryo-preparation and transfer solutions, enabling native-state isotopic and elemental imaging. The NanoSIMS Cryo accessory is integrated into the following workflow:

- State-of-art cryo sample preparation with Leica tools: High Pressure Freezing (HPF), cryo-planning of the HPF carrier, mounting on Leica sample holder in the VCM followed by cryo-coating;
- The VCT500 introduces the sample holder with two HPF carriers into the CAMECA sample holder within the NanoSIMS loadlock. The sample is finally transferred under cryogenic conditions into the analysis chamber for analysis.



High Pressure Freezing with EM ICE



Surface planning with cryo microtome UC Enuity



Sample mounting with VCM cryo workstation



Sample coating with ACE600 cryo coater



Cryo sample exchange with Leica VCT 500

True-to-life Mapping of Signaling Ions in Neurons

Visualizing the native distribution of signaling ions is a major challenge in neuroscience. Calcium, sodium, magnesium and potassium play a central role in neuronal function. Their compartmentalization at the micrometer scale forms ionic microdomains that regulate electrical signaling, synaptic transmission and intracellular communication. Small variations in ion concentrations between dendrites, axons, synaptic terminals and the cell body can profoundly influence neuronal activity. Understanding this organization is essential for linking molecular mechanisms to learning, memory and neurological disorders.

Cryo-prepared neurons reveal strong subcellular compartmentalization and heterogeneous distributions of Na, K, Mg and Ca. In contrast, resin-embedded samples exhibit reduced contrast and evidence of elemental redistribution or precipitation. By preserving the native state of the sample, NanoSIMS Cryo provides a more representative view of neuronal ion biodistribution and cellular chemistry.



"The true composition of the cell is almost impossible to analyze with existing tools.

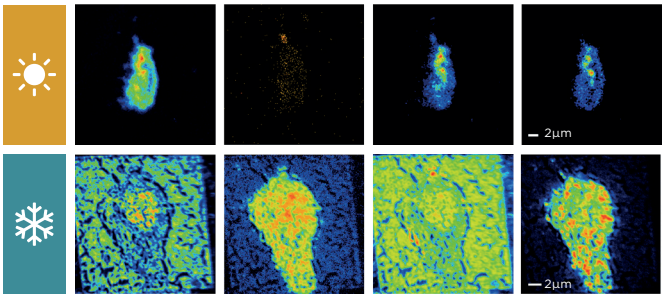
NanoSIMS Cryo finally opens that window – unlocking entirely new discoveries."

Silvio Rizzoli
Full Professor, Chair of Neuro and Sensory Physiology Department, University Medical Center of Göttingen University, Germany



"Free from the artifacts associated with classical preparation methods, NanoSIMS Cryo provides, for the first time, precise insight into the spatial distribution of chemical components in their native state."

Katharina Grewe
NanoSIMS Facility Manager,
University Medical Center of Göttingen University, Germany



Revealing the Microstructure of Reduced-Fat Food Foams

Reducing fat content while preserving texture, flavor, and shelf life is a major challenge in food formulation. Introducing air through foaming is an effective strategy, but foam stability depends on the organization of lipids, surfactants and water at the micrometer scale.

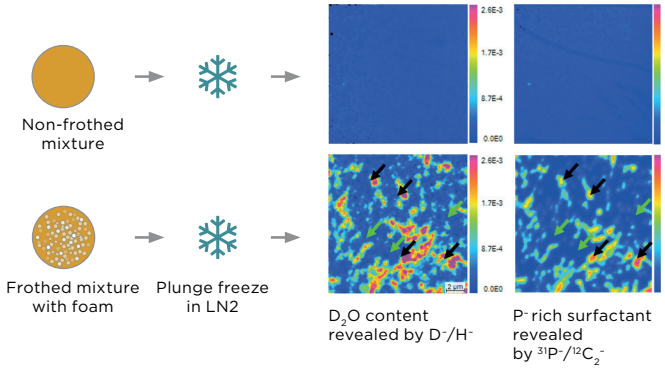
NanoSIMS Cryo reveals clear micrometer-scale differences between a homogeneous mixture and the foam generated by frothing. The system studied consists of a mix of sunflower oil, 5 wt% of Phosphatidylcholine Surfactant, 0.1 wt% of D_2O. The non-frothed mixture shows uniform distributions of deuterium and phosphorus, whereas the foam exhibits strong spatial correlations between D^-/H^- and $^{31}P^-/^{12}C_2^-$ signals. Phospholipids accumulate at newly created air–oil interfaces, forming micrometer-sized clusters, while D_2O associates with their hydrophilic headgroups.

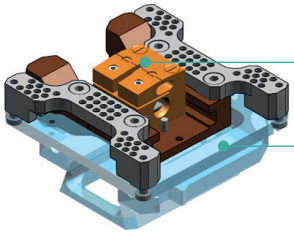
These observations demonstrate how whipping redistributes surfactants at air–oil interfaces, providing direct insight into the mechanisms governing foam structure and stability.

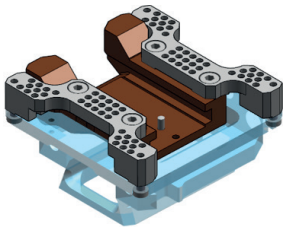


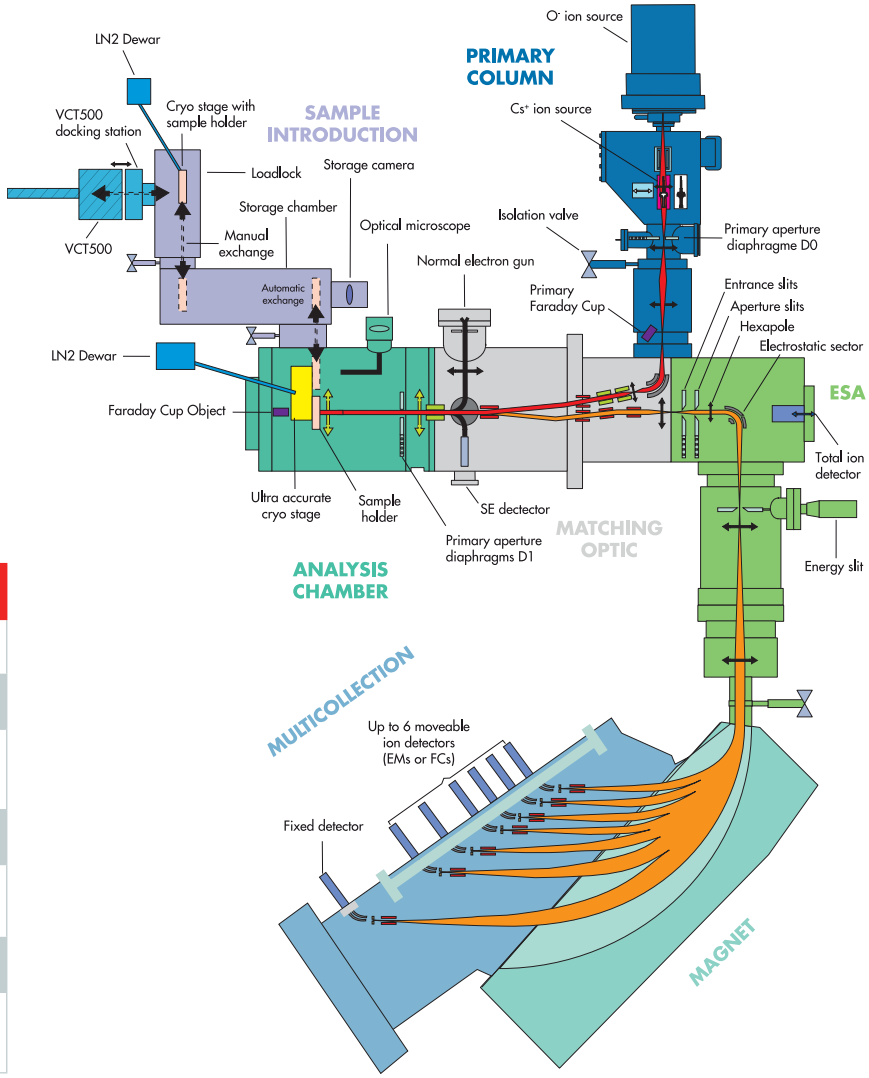
"The isotopic & chemical heterogeneity of soft matter remains largely unexplored at the micrometer scale. Complementing conventional bulk analytical techniques, NanoSIMS Cryo offers a new perspective that can support the development and formulation of safer and more sustainable everyday products."

Anne-Laure Fameau
Research Director at the INRAE, Lille University, France









NanoSIMS Cryo: Overview

Cryo stage in loadlock and analysis chamber
Cryo sample introduction with VCT500
Introduction of up to 2 High Pressure Freezing carriers
System readiness < 4hr
Sample's introduction from loadloack into analysis chamber < 5min
Footprint L 6.80m / W 5.20m / H 2.85m
Command interface for loading Leica sample holder into the NanoSIMS Cryo

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