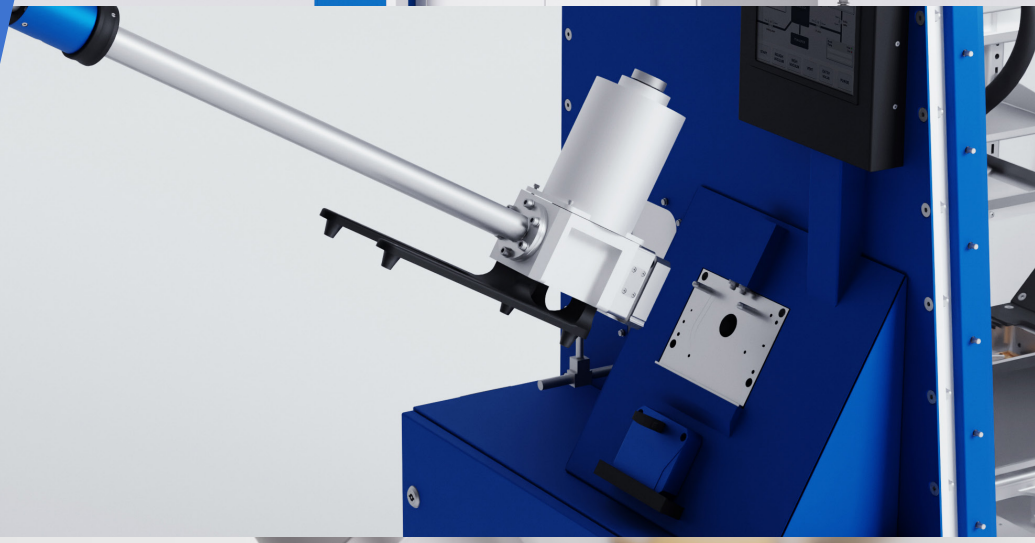
# ceres
## Ice Defence System

Obtain High Quality Cryo-EM Samples and High Throughput by Minimizing Ice Contamination

delmic

# CERES
## Ice Defence System

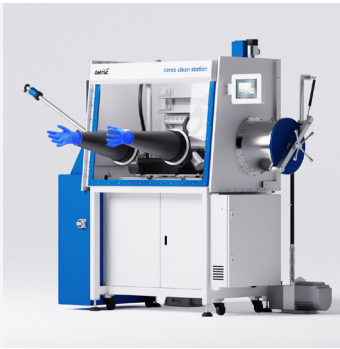
Minimize ice contamination at every step of your cryo electron microscopy (cryo-EM) workflow – preparation, transfer and lamella generation.

Obtain better quality cryo-EM and cryo electron tomography (cryo-ET) results, higher throughput, and higher resolution.

Get powerful insight into the building blocks of life more easily with the innovative CERES series.

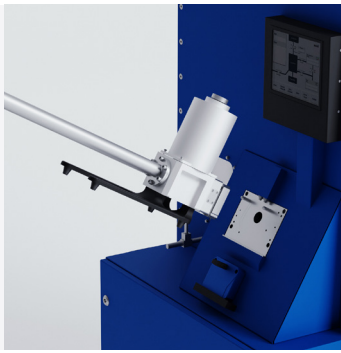
### CERES Clean Station Prepare cryo-EM samples in the bespoke and highly effective Clean Station for complete protection against ice contamination

- Prepare your cryo-EM samples in an anhydrous enclosure (<1% humidity / 1 ppm water) with ease at every step.
- More effective, more comfortable, and environmentally friendly than a low humidity room.



### CERES Vitri-Lock A high vacuum cryo transfer module that enables safe and ice contamination-free cryo sample transfer

- Transport your cryogenic sample between the CERES Clean Station and the cryo-focused ion beam (FIB) / scanning electron microscope (SEM) in high vacuum to minimize the presence of moisture during the transfer.
- Keep samples vitrified for up to 30 minutes thanks to the actively cooled chamber.



### CERES Ice Shield Offers the ultimate protection against ice contamination during lamellae preparation

- Protect your cryo-sample from parasitic ice growth during lamella milling using our patented technology.
- Prepare more ice contamination-free lamellae using your cryo-FIB to obtain high quality tomograms and high throughput.

# Introduction to **CERES Ice Defence System**

The CERES Ice Defence System was created to help researchers in the cryo-ET field obtain higher quality EM data faster.

CERES is the result of the close partnership between DELMIC Cryo and Max Planck Institute for Molecular Physiology, Dortmund, Germany. CERES not only embodies innovations, but also high quality engineering. With CERES, cryo-EM and cryo-ET users can experience an unprecedented high sample yield.

Cryo-ET is a great tool for understanding the building blocks of life due to the high effectiveness in preserving biological samples in their near native state and the atomic resolution. By gaining insight into the structure and organisation of the biomolecules, we can also better understand how they work and how to target specific mechanisms leading to smarter medicine.

## The great ice contamination challenge

A common challenge in the cryo-ET workflows is to keep samples vitrified and ice contamination free. Every scientist knows that the key to high quality data is to have good samples. Crystalline ice formed on or in the sample can obscure the region of interest and significantly lower the cryo-ET data quality.

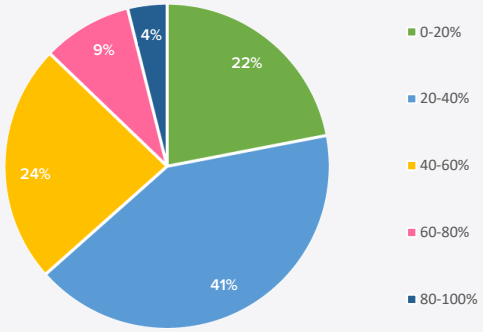
We conducted a survey inviting over 80 cryo-ET scientists to tell us about their ice contamination challenges. We learned that on average 43% of the samples have some forms of ice contamination. 36% of the participants say that they realise there is an ice contamination issue when they are at the cryo-FIB/SEM. 39% of the participants find out about the ice contamination when they are at the cryo-transmission electron microscope (cryo-TEM) – the very end stage of the cryo-ET workflow.

### Problem statements from our survey participants

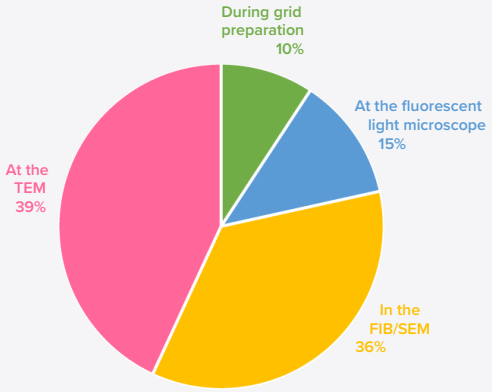
> *“ The experiment results are heavily affected due to ice contamination. ”*

> *“ Ice particles on cell surfaces shadow the protective coating. If the particles come off, it leaves behind an unprotected area. Ice film growth also increases the thickness of lamellae produced, reducing biological contrast. ”*

> *“ Contamination from the FIB-SEM chamber and during unloading. ”*




On average, how many percent of your cryo samples are ice contaminated?




At what point of the cryo-ET workflow do you realise the samples are ice contaminated?

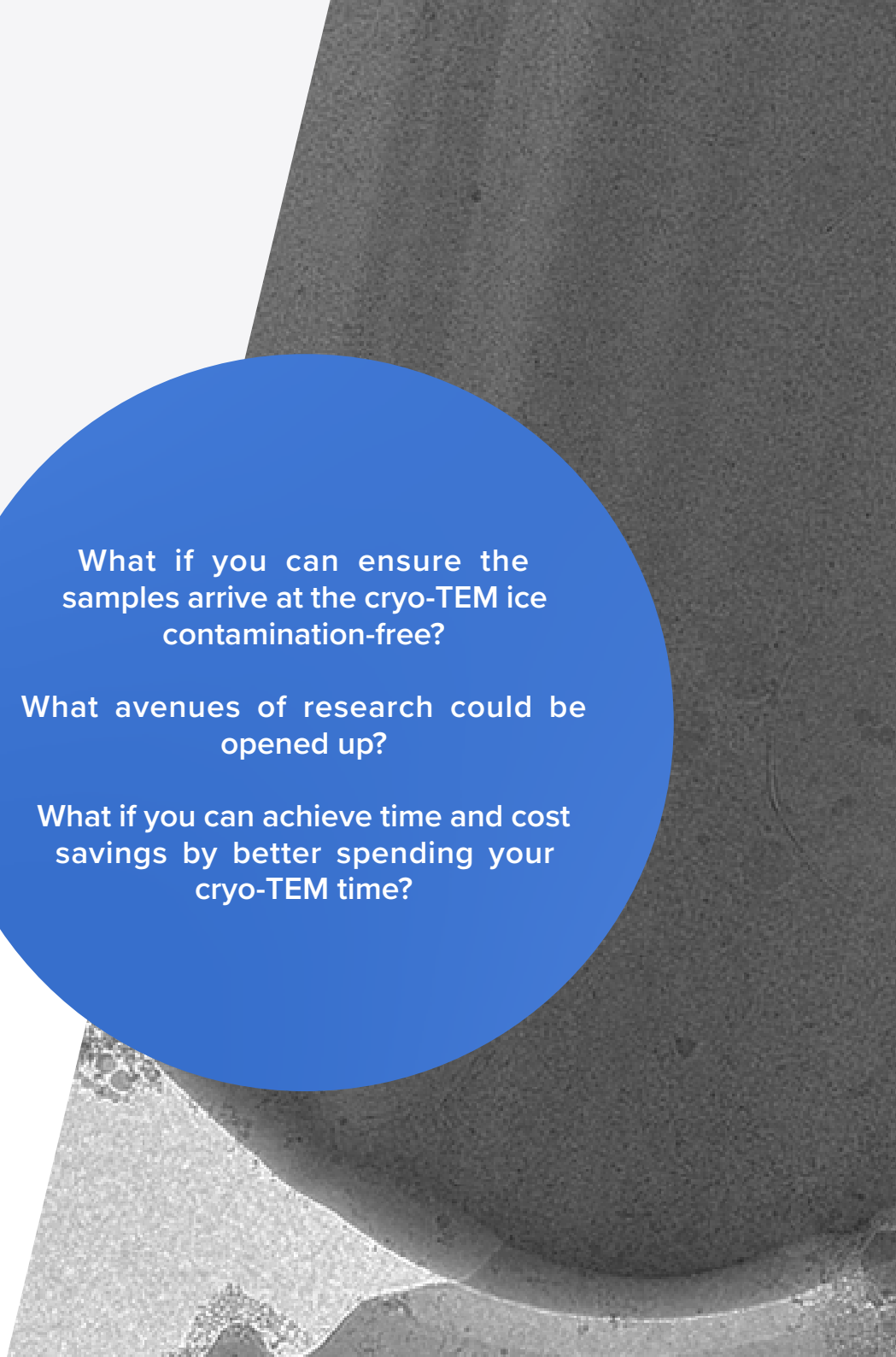
The effects of ice contamination on the cryo-samples can be devastating in some cases – obscuring the region of the rare events, wasting cell samples that took weeks to prepare, or even precious human patient samples.

Not only is the cryo-FIB/SEM and cryo-TEM instrument time costly, the sample preparation procedure is also very time-consuming. What if you can ensure the samples arrive at the cryo-TEM ice contamination-free? What avenues of research could be opened up? How would you like to get much higher throughput and better quality data? What if you can achieve time and cost savings by better spending your cryo-TEM time?

**What if you can ensure the samples arrive at the cryo-TEM ice contamination-free?**

**What avenues of research could be opened up?**

**What if you can achieve time and cost savings by better spending your cryo-TEM time?**

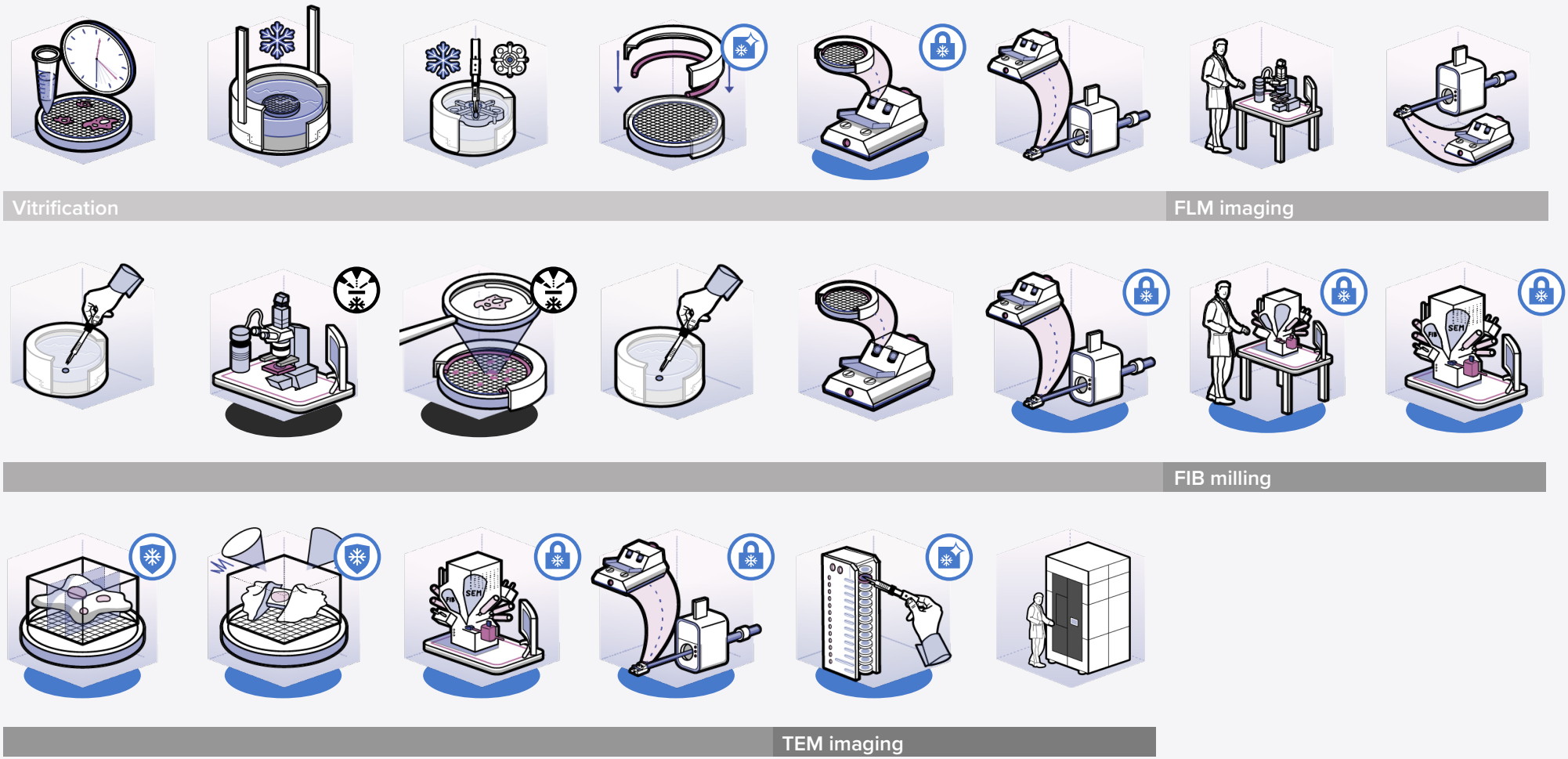


Solution

## CERES Ice Defence System gives you higher sample yields, better quality EM data, and boosts your productivity

Ice contamination happens when moisture in the sample environment condenses onto the cryo-sample. It can happen in various steps of the cryo-EM workflows. In order to tackle this issue, the CERES Ice Defence System consists of multiple tools that are tailored to minimize ice contamination at the different steps. With CERES Ice Defence System you can expect higher throughput throughout your cryo-ET workflow.

For more information about **Delmic METEOR**, the only commercially available integrated cryo-fluorescence light microscopy (FLM) aimed at reducing transfer steps, please visit our website.



# ceres clean station

Cryo solutions by Delmic

The CERES Clean Station provides a clean and moisture free environment for cryo-EM users to prepare samples with ease. It is designed for high effectiveness with the comfort of the user in mind.

## Effective and environmentally friendly

During the cryo-EM sample preparation, amorphous ice can form on/in the sample due to the moisture in the atmosphere. Low humidity rooms are installed in some institutes to tackle this issue. However, these rooms typically only reach a humidity of 20% at best and are not environmentally friendly due to the high energy consumption. In addition, the energy bills associated with running the low humidity rooms are significant.

The CERES Clean Station constitutes a dry nitrogen gas-purged, gloved enclosure, and load-locks to maintain a less than 1 ppm water environment for your sample preparation procedure. All controlled automatically with just a single button press.

**Whether you are performing single particle analysis or cryo-ET, the CERES Clean Station is your perfect partner for an ice contamination-free sample preparation.**

## User-friendly

The liquid nitrogen-filled preparation table provides a safe and user-friendly sample preparation platform. The preparation table consists of three modules specifically designed for:

1. AutoGrid-shuttle loading
2. AutoGrid-shuttle transfer
3. Autoloader cassette loading

Additionally, the table facilitaties the clipping of grids in conjuction with the ThermoFisher Scientific clipping station.

Thus, whether you are performing single particle analysis or cryo-ET, the CERES Clean Station is your perfect partner for an ice contamination-free sample preparation.

Position the appropriate module in front of you using the sliding rails to work with ease. Place the tools on the heated rack when not in use to keep them ice free.

## Seamless and contamination-free transfer

When you have prepared your AutoGrid-shuttle and you are ready to transfer it to your cryo-FIB/SEM for imaging or for lamella preparation, load the shuttle into the CERES Vitri-Lock through the interface without exposing the shuttle to the atmosphere and keep your samples uncontaminated.

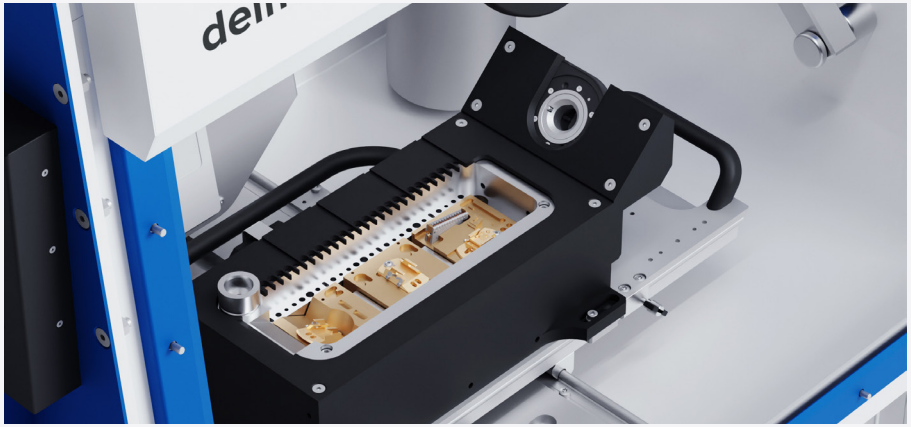
After loading the Autoloader cassette with AutoGrids in the Clean Station, place the cassette in the NanoCab to transfer out of the Clean Station through the load lock.

## Innovative technologies to stay moisture free

CERES Clean Stations stays moisture free by the following innovative designs that take care of every step of the preparation:

| Preparation step | Innovative Design | Advantages |
|---|---|---|
| Samples and vehicles introduction into, and removal from, the enclosure | An airlock fitted with air purifier and vacuum pump | Minimize the introduction of moisture into the Clean Station when inserting samples and vehicles into the enclosure |
| During sample preparation | Dry nitrogen purging and recirculating purification | Removal of moisture from the environment |
| | Direct feedthrough to fill preparation table with liquid nitrogen | Keep the samples vitrified during all preparation steps safely and conveniently |
| When not in use | Individual heaters for each module and tool rack | Evaporate any moisture in the environment ready for the next use |

Want to know how CERES Clean Station can enhance your research outputs? Please contact us by visiting our website.

# ceres vitri-lock

Cryo solutions by Delmic

CERES Vitri-Lock uniquely enables your cryo-sample transfer to take place in a high vacuum, anhydrous environment, to ensure your samples stay uncontaminated during the transfer to and from the cryo-SEM/FIB.

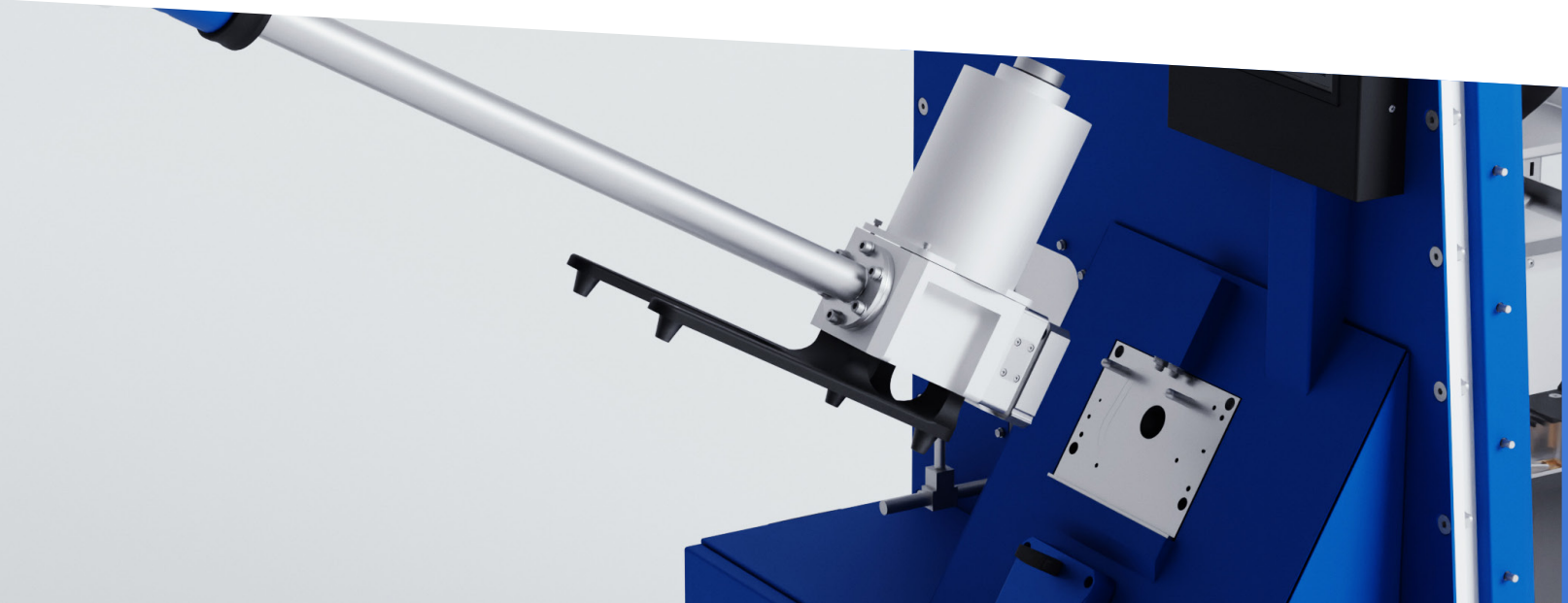
The current commercially available solutions transfer the samples in low/mid-vacuum and with a limited ‘cold time’, risking ice contamination and devitrification during the transfer.

## Longer cold time and safer transfer

CERES Vitri-Lock enables a safe transfer time for up to 30 minutes, ensuring your samples stay vitrified without the need for rushing between stations. The prolonged ‘cold time’ compared with the other commercially available cryo-transfers enable users to keep their samples vitrified and contamination-free even during the lengthy sample screening step.

Use CERES Vitri-Lock together with CERES Clean Station to ensure a seamless sample transfer in an anhydrous environment. Once the sample is transferred into the Vitri-Lock, the CERES Clean Station pumps the Vitri-Lock sample chamber down to high vacuum.

Want to know how CERES Vitri-Lock can enhance your research outputs? Please contact us by visiting our website.



The chamber is uniquely actively cooled on the exterior by a liquid nitrogen reservoir, keeping the sample below at -150 °C while maintaining a high vacuum transfer environment through cryo-pumping.

# ceres ice shield

Cryo solutions by Delmic

CERES Ice Shield offers your cryo samples the maximum ice contamination protection during lamella milling in the cryo-FIB.

CERES Ice Shield is liquid nitrogen-cooled and provides cryo-pumping to lower the partial pressure of water in the chamber and sample vicinity, thus reducing amorphous ice growth to a non-measurable level.

Did you know that the typical 50 nm/hour ice growth rate accepted by cryo-FIB providers would mean your 150 nm lamella could become several times thicker at the end of a sample preparation session?

With the patented, innovative cryo shutter design, your cryo sample is particularly shielded from the contamination originating from the electron column, and therefore preventing condensation on the sample. With the >10-fold decrease in ice contamination rate (Figures 1 and 2), you can prepare many more lamellae before the first lamella becomes covered in ice.

## Total protection without changes to your workflow.

The cryo shutter automatically retracts when SEM imaging takes place and replaces itself back for maximum protection against ice contamination.

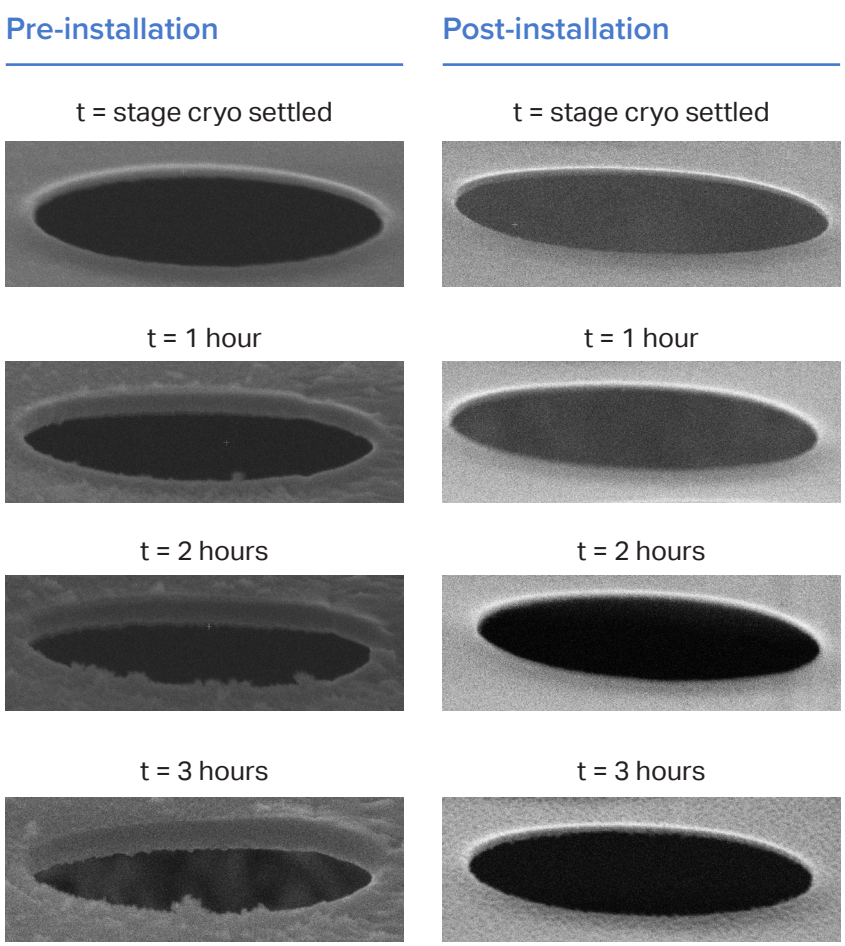



*Figure 1* *Examples of 2 µm diametre grid holes of R2/2 200 mesh TEM grids imaged at a 15° angle at different time points. Pre-installation images show an increasingly thick layer of ice accumulating on the grid, while the images post-installation show little to no ice accumulation. **

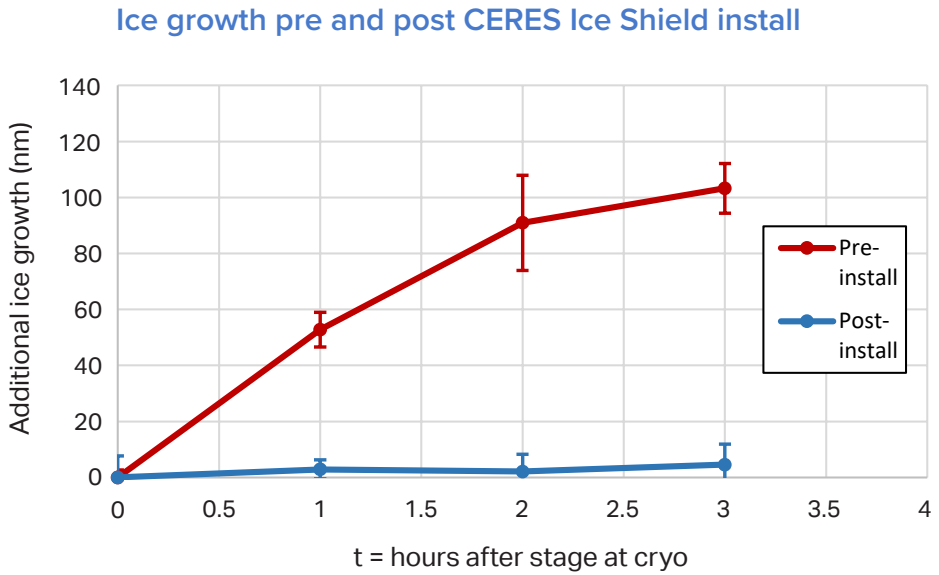



*Figure 2* *The thickness of the foil and ice was measured at set time intervals after the cryo stage reached the working temperature of -190 °C (t=0). The data was normalized to the thickness at t=0 to allow better comparison of the growth over time. The graph shows that the contamination was approximately 45 nm/hour in the first 2 hours after stage cooldown before the CERES Ice Shield installation (red curve). After the installation (blue curve), the increase in thickness is significantly reduced to approximately 5±7 nm after 3 hours. **

* *Data courtesy of Prof F. Förster and Dr S.C. Howes, Structural Biochemistry, Bijvoet Centre for Biomolecular Research, Utrecht University.*

Prepare more uncontaminated lamellae from your samples, obtain a higher throughput and better quality tomograms.

**Essential for automated cryo-FIB procedures**

Are you aiming to perform automated cryo-lamella preparation to achieve high throughput? Imagine if most of your automatically milled lamellae are ice contaminated, how would that affect your research output?

With CERES Ice Shield, you can be confident that parasitic ice growth will not be the limiting factor.

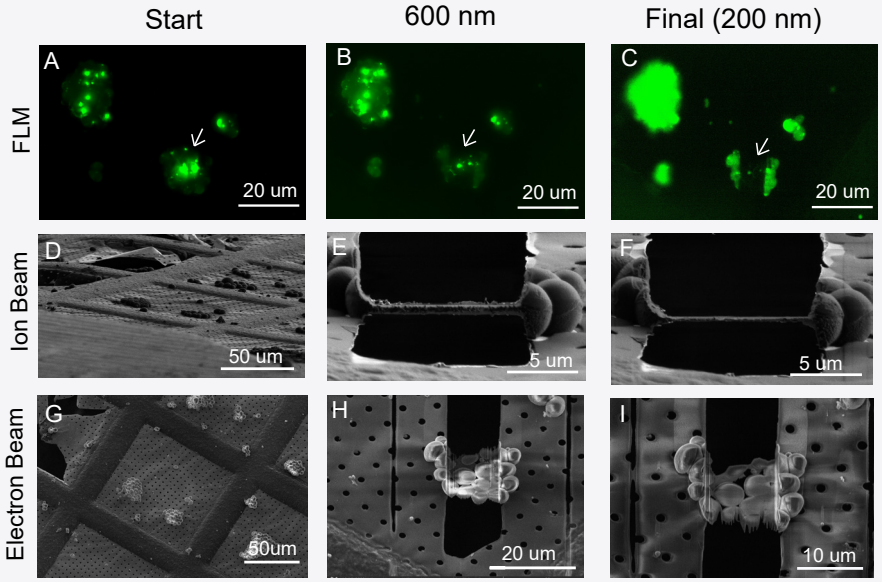
Want to know how CERES Ice Shield can enhance your research outputs? Please contact us by visiting our website.

meteor

Cryo solutions by Delmic

## Use METEOR and CERES together to boost sample yield and productivity through ice contamination minimization and integrated fluorescence microscopy-guided lamella milling.

For more information about Delmic METEOR, the only commercially available integrated cryo-FLM aimed at reducing transfer steps, please visit our website.


*Correlative cryo-FIB milling images taken at the start of milling, 600 nm and 200 nm lamella thickness using different imaging modalities (FLM, ion beam and electron beam). (A-C) Maximum intensity projections of FLM Z-stacks (70 slices at 400 nm steps, objective: Olympus LMPLFLN 50X/0.5, LED excitation of 484 nm and a 525/30 nm emission filter). The targeted lamella is indicated by a white arrow. (D-F) Ion Beam images (HV: 30 kV, curr: 30 pA, det: ICE) (G-I) Electron beam images (HV: 5 kV curr: 25 pA t: 1us det: ETD). Images courtesy of Cristina Capitanio, Anna Bieber, Oda Schioetz, Philipp Erdmann and Juergen Plitzko, Max Planck Institute for Biochemistry, Germany.*

# Specifications

## ceres clean station

| Item description | Specifications |
|---|---|
| **Compatible workflow** | Single particle analysis, cryo-ET |
| **Compaticle cryo sample vehicles** | TEM grid shuttle, NanoCab |
| **Humidity level in the enclosure** | <20 ppm water |
| **Anti-humidity method** | Air purification recirculation with dry nitrogen gas purging**, load lock and airlock entries |
| **Gas flow** | Continuous |
| **Air purifier** | Replaceable HEPA filters |
| **Humidity level display and control** | Digital / PLC |
| **Compatible cryo transfer devices** | DELMIC CERES Vitri-Lock, ThermoFisher cryo transfer device |
| **Load lock vacuum pump pressure levels** | Up to $1x10^{-6}$ mbar for CERES Vitri-Lock, up to $1x10^{-2}$ mbar otherwise |
| **Preparation station cooling agent** | Liquid nitrogen** |
| **Preparation station working temperature** | -165 °C |
| **Preparation station cooling agent refill method** | Insulated hose connected with an external liquid pressurized nitrogen dewar** |
| **Dimensions** | 2000 mm (height) x 2000 mm (width) x 850 mm (depth) |

** *Dry nitrogen gas and liquid nitrogen to be supplied by the user*

# Specifications

## ceres vitri-lock

| Item description | Specifications |
|---|---|
| Compatible workflows | Cryo-SEM, Cryo-ET |
| Compatible sample | TEM grid-shuttle |
| Compatible cryo-FIB model | ThermoFisher Scios, Helios Hydra, Aquilos and Aquilos 2; For other cryo-FIB models, please discuss with your Delmic representative |
| Anti-humidity method | High vacuum (up to $1x10^{-6}$ mbar) |
| Chamber cooling agent | Liquid nitrogen |

## ceres ice shield

| Item description | Version 1 | Version 2 |
|---|---|---|
| **Compatible workflow** | Cryo-ET – on-grid milling and lift-out*** | |
| **Ice Shield cooling method** | Independent cooling system consisting of an on-column liquid nitrogen dewar | Utilises the cooling system of the cryo-FIB/SEM |
| **Anti-ice contamination method** | Retractable liquid nitrogen-cooled cryo shutter drastically lowers the partial pressure of water in the sample vicinity and protects the sample from the line of sight of the electron column (the main source of contamination) | |
| **Run time** | Approximately 5 hours (the exact rate depends on the room environment), extend by manual liquid nitrogen refill | Equal to the cryo stage run time |
| **Compatible cryo-FIB/SEM models** | Thermo Scientific Scios, Aquilos<br><br>For other cryo-FIB models, please enquire through your local DELMIC representative. | Thermo Scientific Aquilos, Aquilos 2<br><br>For other cryo-FIB models, please enquire through your local DELMIC representative. |

*** *The CERES Ice Shield is intended for protecting the cryo sample from ice contamination during the lamella thinning and polishing step of the lift-out workflow only.*

## Interested?

For more information on this topic visit www.delmic.com

## About

Delmic is a passionate high-tech company based in Delft, the Netherlands that develops powerful and user-friendly solutions for light and electron microscopy. Our systems are used by researchers and companies all over the world in fields ranging from life sciences, geology, material sciences to nanophotonics.

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