CoolerHeater Accessory for Jupiter XR AFM

OXFORD INSTRUMENTS
ASYLUM RESEARCH

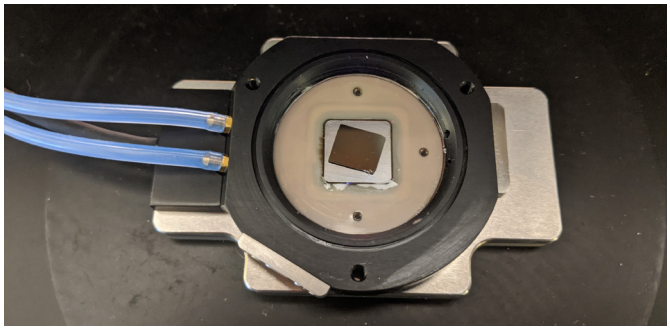
The CoolerHeater™ accessory for the Jupiter™ XR AFM heats and cools samples, up to 15 mm in diameter, from -30°C to +120°C while allowing for high quality imaging. In combination with blueDrive™, the CoolerHeater is an ideal accessory for a wide range of thermally-controlled experiments.

CoolerHeater Experiments

From polymer melting and crystallization, to device failure testing, the ability to cool and heat samples as they are imaged by an AFM is important for material characterization. The CoolerHeater allows for nanoscale structural and mechanical changes to be observed at the same time as the sample temperature is varied.

CoolerHeater Ease of Use

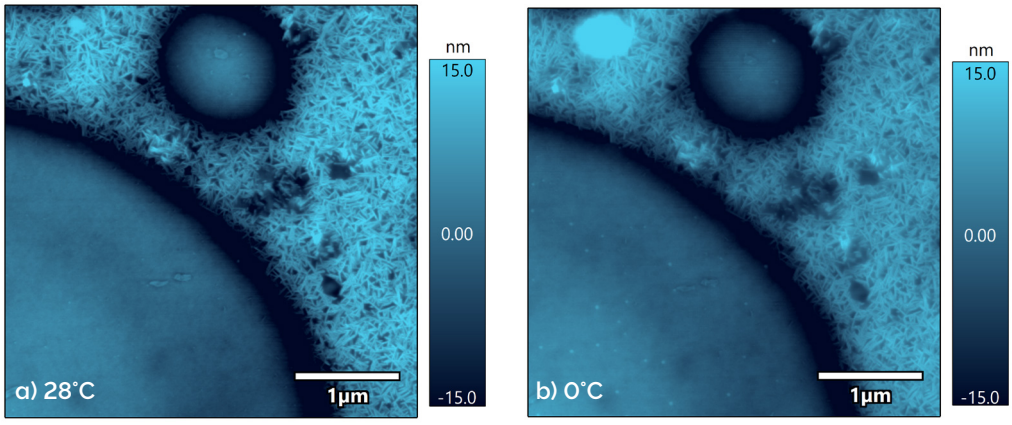
The CoolerHeater accessory uses a Peltier element to heat and cool samples placed directly on the sample mount. For ease of use, there are several options to immobilize samples on the mount. Samples may be attached to standard metal AFM sample discs and placed directly on the temperature controlled metal surface of the stage to be held magnetically. Free standing samples can be immobilized using metal clips. Alternatively, thermally conductive paste can serve as the sample immobilization method. The temperature controlled surface of the CoolerHeater stage has an active area of 15 × 15 mm and can hold slightly larger samples. The heating/cooling surface is sealed into the CoolerHeater assembly, allowing for liquid drop experiments (with liquid compatible cantilever holder) without accessory damage or electrical short circuits. The stage has four convenient access ports that allow for dry or inert gas input, injection of fluids, or electrical access. An optional cantilever holder with a flexible membrane can be used to create a semi-sealed imaging environment.



CoolerHeater sample stage. The sample can be immobilized on the cooling/heating stage magnetically, with thermally conductive paste (shown here), or using clamps.

blueDrive for Imaging Stability

Asylum Research's exclusive blueDrive technology improves tapping mode-based imaging techniques by replacing piezoacoustic excitation of the cantilever with photothermal excitation. With blueDrive, cantilever tuning is clean and avoids the so-called "forest of peaks". Having only one peak simplifies the tuning procedure and speeds up the experimental setup. Additionally, unlike piezoacoustic drive, blueDrive is both stable over time, enabling extended periods of data collection without any adjustments by the user, and lower noise.

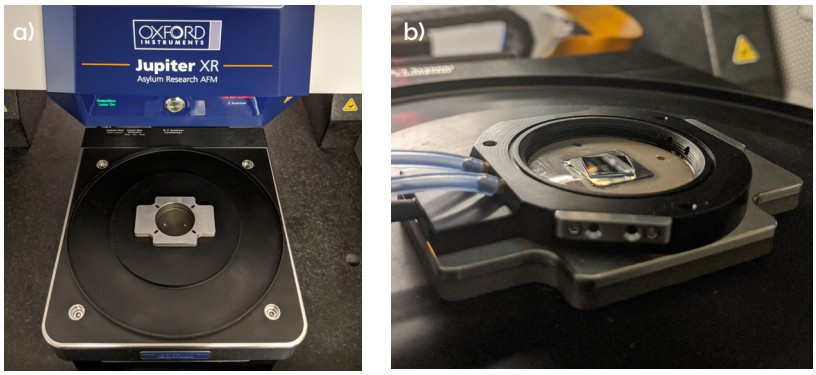


Topography images of thin PS/PP polymer film. As the temperature was decreased from a) 28°C to b) 0°C, the formation of an ice aggregate was observed.

(5×5 µm images, 4.88 Hz scan rate using blueDrive)

Accessory chuck for safe accessory operation

The accessory chuck has an embedded ID chip which is automatically recognized by the software to simplify the experimental setup. The accessory chuck provides a stable XY scanner attachment base for the accessories and its flexible membrane protects the AFM from accidental liquid spills.



a) Accessory chuck placed on the XY scanner b) Close up view of the cooler heater cell mounted on the accessory chuck.

Environmental Control Card Closed Loop Accuracy

The CoolerHeater requires the environmental control expansion card, which plugs directly to the Jupiter expansion port. It ensures closed-loop performance independent of the AFM controller. All control and measurement functions are fully programmable through the software interface, including built-in support for temperature ramps. Fully integrated temperature information is stored with each AFM image. SmartStart allows plug and play operation without the use of parameter files.

Specifications

The CoolerHeater kit includes the CoolerHeater sample stage, cooling fluid pump, and an accessory kit containing an initial supply of consumable items required for operation. The CoolerHeater also requires an environmental control expansion card and accessory chuck that can be shared with other environmental control accessories.

Temperature control

- 0˚C to +120˚C without cooling pump
- -25˚C to +120˚C with cooling pump and room temperature coolant
- -30˚C to +120˚C with cooling pump and chilled coolant

Environmental control

- Four 1/16" access ports are provided for tubing or electrical connections
- The sample chamber can be semi-sealed to control gas environment with optional cantilever holder

Sample compatibility

- Samples up to 20 mm diameter (15 mm recommended) and 2 mm thickness
- May be operated in gas or in a liquid droplet (with a liquid compatible cantilever holder)
- Supports up to 10 mm sample translation

Cleaning

Wipe with alcohol; do not immerse in fluid

System compatibility

Jupiter XR
MFP-3D Infinity™

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