

Introduction

The **CoolerHeater** accessory for the **MFP-3D™** uses a Peltier element to heat and cool small samples within the range of -30°C to +120°C, ideal for a wide range of thermally-controlled experiments.

CoolerHeater Stage

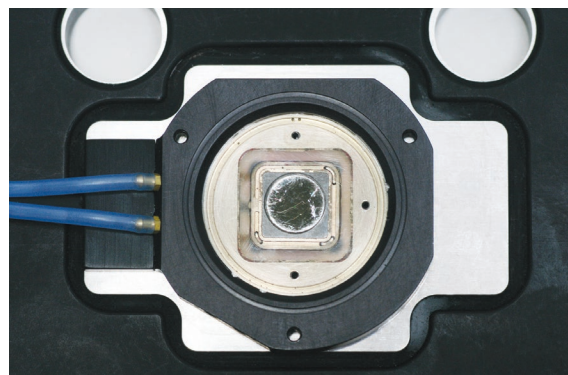
The CoolerHeater stage seals out the ambient environment with a FKM (Viton® equivalent) rubber membrane and O-rings. Four sealed access ports allow for dry or inert gas purge, injection of fluids, or electrical access. Samples can be mounted on standard AFM sample discs and magnetically held to the temperature controlled metal surface. Metal clips can also be used to hold down samples. The temperature controlled surface is 15 x 15 mm but can hold slightly larger samples. This surface is sealed into the heater assembly so liquid drop experiments can be performed without worry of damage or electrical short circuits. The temperature sensor is embedded in the sample stage and slight offsets to the actual sample surface temperature are to be expected. A top illuminated, top view (only) of the sample is possible with the appropriately outfitted MFP-3D AFM.

Fluid Cell

The fluid cell is constructed of durable materials such as anodized aluminum, PEEK, and tungsten. All parts can be cleaned and partially disassembled, although autoclaving or complete immersion is not recommended. For liquid drop experiments, a small drop can be placed on a thin piece of mica or glass epoxied to a magnetic AFM disc. The drop will then be in contact with the mica/glass and the AFM cantilever holder, which is constructed of PEEK, quartz, and stainless steel.



The CoolerHeater, showing the Environmental Controller, the coolant pump, and the sample holder stage.



CoolerHeater stage with magnetically mounted 12 mm mica disk.

Coolant Pump

A coolant pump is required for measurements below ~0°C when the Peltier generates sufficient heat. A trickle of cooling fluid prevents the stage from overheating. Room temperature coolant is supplied to a closed cooling liquid circuit that includes a computer controlled pump and two reservoirs (pictured left). To achieve the lowest possible temperatures (i.e. -30°C), the coolant reservoirs can be detached from the pump base and immersed in chilled water. Safety sensors prevent the heating stage from overheating in case of an insufficient cooling water supply. The coolant pump is a SmartStart™ device that autoconfigures upon plug-in. The coolant flow rate is software controlled.

Environmental Controller – Closed Loop Accuracy

The CoolerHeater requires the Environmental Controller (purchased separately). The built-in microprocessor maintains closed loop performance independent of the AFM controller. All control and measurement functions are fully programmable through the software interface, including built-in capability 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 includes the CoolerHeater stage, cooling fluid pump, and an accessory kit containing an initial supply of consumable items required for operation. The CoolerHeater also requires the Environmental Controller, which must be purchased separately and can be shared with other MFP-3D 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

- Sample chamber can be fully sealed to control gas environment
- Four 1/16" access ports are provided for tubing or electrical connections

Sample compatibility

- Samples up to 15 mm diameter and 2 mm thickness
- May be operated in gas or in a liquid droplet
- Supports up to 10 mm coarse sample translation

Cleaning

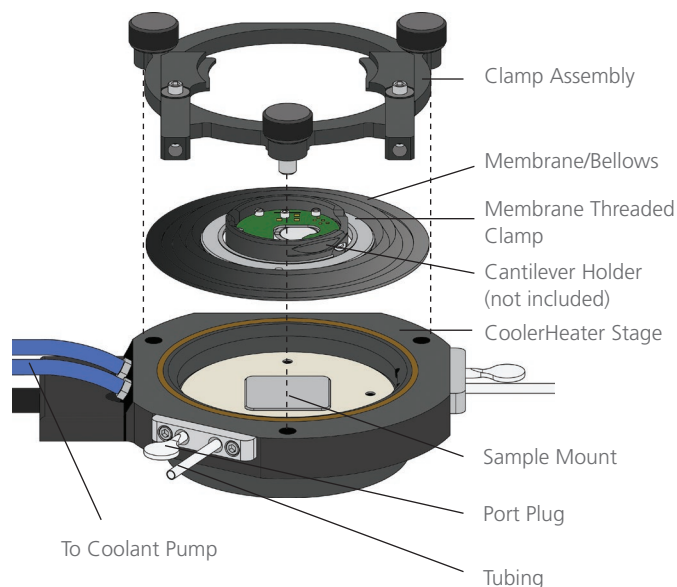
- Swap with alcohol; not immerse in fluid
- Not autoclavable

System compatibility

- Compatible with all MFP-3D AFMs except the MFP-3D Origin™

Environmental Controller

- Closed loop operation
- SmartStart for plug and play operation
- Operates at 110 or 220 VAC
- CE tested
- Built-in microprocessor for temperature control
- Fully programmable through the MFP-3D software



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