

NanoEx-i/v

TEM holder for heating and biasing

MEMS-device based solution for *in situ* atomic-resolution imaging at elevated temperatures

A better solution

Classical TEM heating holders use a furnace to heat a $\varnothing 3\text{mm}$ TEM grid sample. As a consequence, the furnace also heats most of the holder tip, leading to increased drift and reduced resolution during *in situ* experiments.

The Thermo Scientific™ NanoEx™-i/v TEM single-tilt heating/biasing solution offers features unavailable on other heating stages and will extend your range of applications.

Faster time to data

The NanoEx-i/v heating holder for *in situ* experiments uses a small, consumable semiconductor (MEMS) device as the heater. The device itself has a considerably smaller thermal mass, therefore is designed to increase heating speed and reduce thermal drift, allowing rapid acquisition of images from your experiment, even at atomic resolution.

Accurate monitoring of experiment parameters

The design of the NanoEx-i/v heating holder is optimized to provide a direct read-out of the temperature value at all times during your experiment with a known and reproducible temperature distribution over the heated area. It enables reproducibility in repetitive and cycling experiments for ultimate control over experiment parameters.

Multi-purpose *in situ* holder

From now on you can combine *in situ* heating experiments with electrical measurements (e.g. biasing). The NanoEx-i/v solution has four additional electrical contacts that can be used for simultaneous biasing experiments.

ChemiSTEM elemental mapping at elevated temperature

The NanoEx-i/v solution is optimized for use with the Thermo Scientific™ ChemiSTEM™ Technology for EDS experiments that trace compositional changes correlated to temperature and electrical stimuli.

Integration within new Thermo Scientific TEM platforms

The NanoEx-i/v works with guaranteed performance on the Thermo Scientific TEM platforms. Embedded control software has been developed for remote operations (e.g. on Talos™ and Themis TEM) to perfect mechanical, thermal and electrical stability during *in situ* experiments.

Key benefits

Optimized for studies on nanomaterials. NanoEx-i/v accepts a variety of sample geometries from nanoparticles to FIB lamellas on its thin amorphous support film that includes film-free areas.

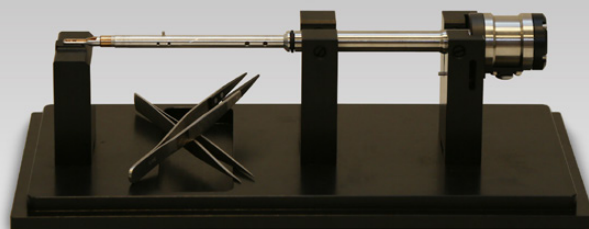
Rapid & precise heating. Fast heating of nanomaterials to more than 1000 °C with precise control via direct temperature read-out (e.g. for closed loop settings).

Stable solution for *in situ* atomic scale imaging. NanoEx-i/v has been developed with high-resolution imaging performance in mind. It guarantees TEM performance at heating temperatures, as well as in electrical biasing experiments.

Uniform temperature distribution. The MEMS device design of NanoEx-i/v delivers consistent, reproducible and uniform temperature distribution over the heated area.

Combine *in situ* and analytical experiments. NanoEx is optimized—and approved—for use with our Super X EDS detector and ChemiSTEM technology.

One stop solution for assured performance. Integration with control software for remote operation (e.g. on Talos and Themis TEM platforms).



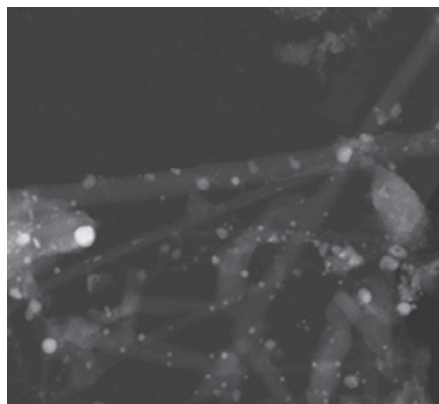


Figure 1. STEM image at 500

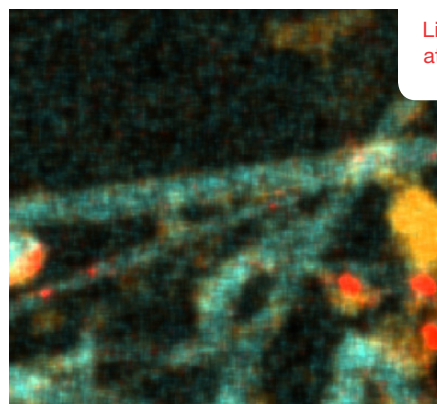


Figure 2. EDS map at RT

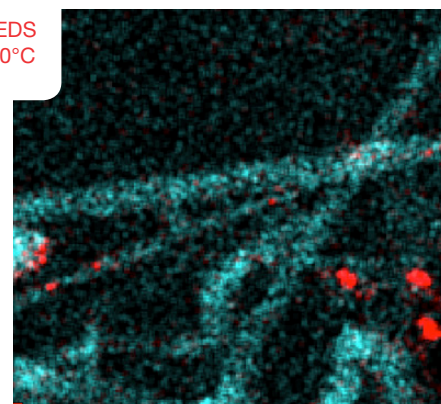


Figure 3. EDS map

Nanoex capabilities

Operating temperature	Up to 1200 °C Guaranteed lifetime specifications for RT – 1000 °C*
Atomic scale imaging at all temperatures	Depending on microscope performance*
Low drift rates in <i>in situ</i> experiments	Please contact Thermo Fisher Scientific for additional information
Direct temperature feedback from MEMS device	Operates in closed-loop as well as in open-loop mode
Temperature accuracy	<4% (with 0.1 °C readout accuracy)
Temperature stability	3 °C in 1 hr (point-to-point)
Uniform temperature distribution over heated area	Over area with electron-transparent windows*
Optimized for temperature cycling experiments	No performance degradation (e.g. in temperature accuracy) in long term experiments, even with multiple temperature ramps*
EDS compatible	Approved for use with the Thermo Scientific ChemiSTEM Technology*
Simultaneous heating and biasing experiments	8 electrical feedthroughs (hardware and software enabled) 4 for heating, 4 for biasing*
Control software for heating and biasing operation	Python-based user interface (UI) on microscope PC* Detailed logging of experimental parameters
Holder tilt-range in CompuStage	Holder geometry is suitable for high tilt angles in the S-TWIN and X-TWIN objective lens (also compatible with U-TWIN objective lens, but with a limited tilt range)

*Please contact Thermo Fisher for additional information

System requirements

NanoEx is optimized for use on Thermo Scientific products Talos, Themis 200/300 TEM and Themis Z TEM. Also available for retrofit on earlier Thermo Scientific TEM platforms*

Find out more at thermofisher.com/EM-Sales

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