VAHEAT

DYNAMIC THERMAL CONTROL

Precise temperature control for high-resolution microscopes.

INTERHERENCE

HIGH SENSITIVITY MICROSCOPY

www.interherence.com

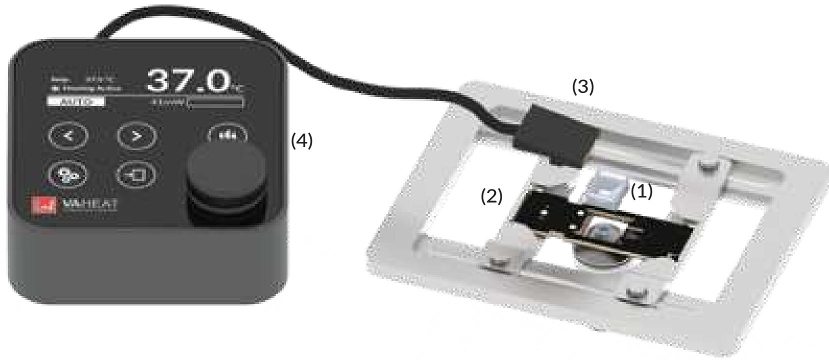
VAHEAT

FAST. SMALL. PRECISE.

VAHEAT is a precise temperature control device for optical microscopes. It combines local heating with direct temperature sensing in the sample volume. This allows for fast and precise temperature adjustment with heating rates up to 100 °C/s. VAHEAT is compatible with most commercial microscopes and objectives.

Key Features

- Operating temperature range RT–105 °C (200 °C optional)
- Heating rates up to 100 °C/s
- Absolute temperature precision of 0.1 °C
- Flexible temperature profile programming
- Full remote control via USB
- Compatible with microfluidics and surface functionalization



(1) Smart Substrate *(3) Probe Head*

(2) Microscope Adapter *(4) Control Unit*

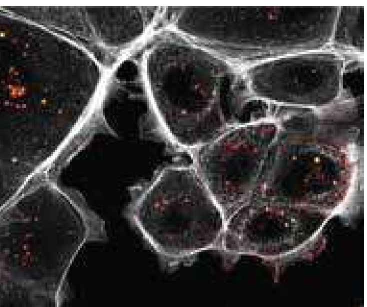
Highlights

- No user calibration necessary
- Highly compact system design
- Simple installation and portability
- Fast and precise temperature control
- No excessive heating of optical components

Compatible Imaging Techniques

- Confocal Microscopy
- Superresolution Microscopy (STORM, PALM, PAINT)
- Widefield and TIRF Imaging
- Fluorescence Lifetime Imaging (FLIM)
- iSCAT
- Atomic Force Microscocopy

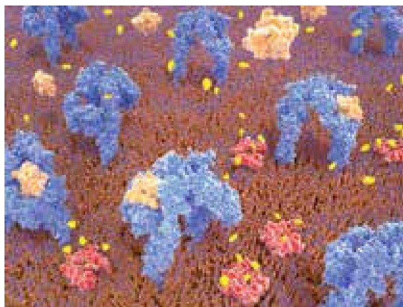
Live Cells



Phase Transitions

DNA nanotechnology

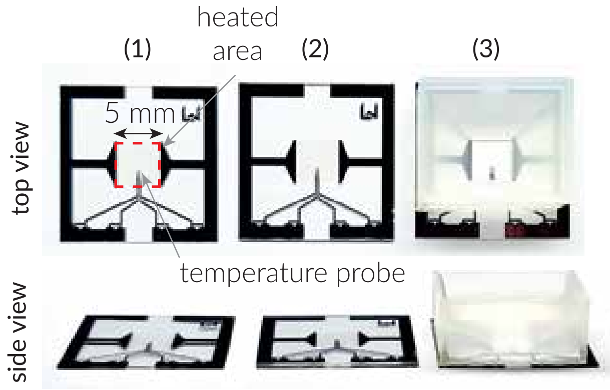
Biophysics



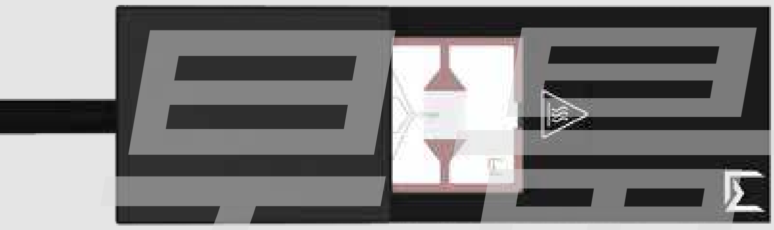
Components

Smart Substrates

Your sample is directly prepared on our smart substrates that combine a transparent heating element with a highly sensitive temperature probe. We offer several types of smart substrates optimized to your need covering live cell imaging, high temperature precision (1), large area heating or extended temepreature range (2). Each substrate can be optionally equipped with silicone reservoirs (3) and flow chambers for cell cultures or other liquid samples. The open reservoirs can be optionally sealed to avoid evaporation.
Each substrate is calibrated in production, eliminating the need for user calibration. Just enter the specified calibration values (R25, TKR) in the settings and you are ready to start your experiment. Substrates are available in packs of 4 or 16 pieces.



Microscope Adapter

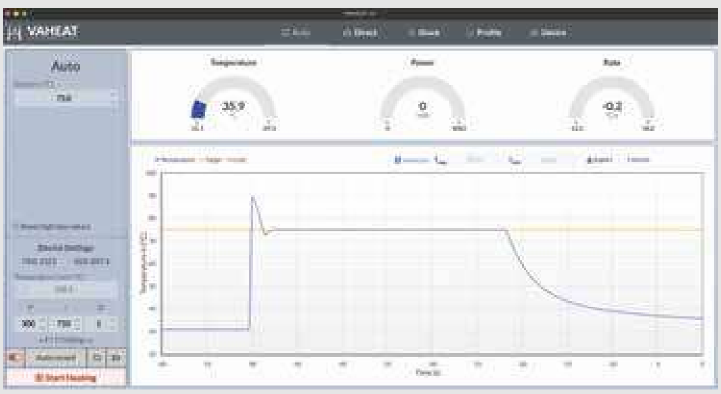


The microscope adapter is the connecting part between the Smart Substrate and the control unit. Its footprint is similar to a standard microscope slide (25×75 mm^2). It can even be combined with white light condenser illumination from above due to its slim design. Compatible with most stage inserts but works best with the stages equipped with metal clips.

Control Unit

The control unit is the interface between you and your sample temperature. It continously displays the current temperature and allows to easily adjust the setpoint by turning a single knob. An USB interface enables remote control and synchronization of the system parameters with your imaging setup. You can run it in the AUTO mode, simply setting up a temperature, to which the device heats your sample. You can set up any temperature program for your experiment in PROFILE mode. DIRECT and SHOCK modes are other fast ways of heating your sample (see manual).

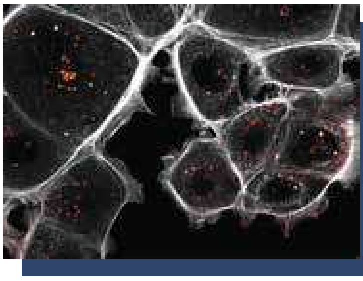
Desktop Application



Our graphical user interface (GUI) allows you to easily track and export the thermal history, and lets you define arbitrary temperature protocols. Simply start a measurement and monitor your temperature remotely.
In the GUI, it is very easy to input the substrate calibration values and change the substrate PID settings. The application can be installed on unlimited number of computers and with the license you gain free access to all the future updates. Available for Windows, macOS as well as Linux users.

Applications

Cell Biology



- Live cell imaging of extremophiles
- Heat shock response, heat sensitive alleles
- Imaging neurons in culture
- Fluorescent biosensors
- Long-term live cell imaging
- Mechanobiology and cytoskeleton

Biophysics

- Liquid-liquid phase separation of proteins
- Plasma membrane biophysics
- Single molecule experiments
- DNA nanotechnology / DNA origami
- SmFRET, protein folding
- Ion channels, electrophysiology

Material Sciences

- Particle diffusion
- Active matter research
- Crystallization and other phase transitions
- Colloidal self assembly

Physics & Industry

- Melting point analysis
- Microfluidics
- Dynamic temperature tuning
- Temperature calibration

References

Dr. Marleen van Wolferen
University of Freiburg,
Germany

"Thanks to VAHEAT, we were able to perform live imaging of cell divisions in thermophilic Archaea for the first time in our lab. Another application, where we successfully used the instrument was to capture the swimming behaviour of Sulfolobus."

Dr. Josef Gotzmann
Max Perutz labs,
Austria

"I have tested VAHEAT in live cell imaging and for in vitro experiments with protein condensation. The device performance convinced me and I think that it could be another flexible option for temperature control for our users. I liked VAHEAT also as a "mere" temperature sensor. Perfect for quality control options for facility people, but also for individual users."

Dr. Senthil Arumugam
Monash University,
Australia

"One part of my laboratory works on transcription factors in the germline of C.elegans and liquid-liquid phase separation. Temperature dependence is one of the better ways to show whether protein foci are formed by a phase transition mechanism or not. I have done temperature dependent experiments in the past with a home built system and I know how difficult it is. Compared to that, the VAHEAT system is really easy to use across many microscopes and samples. We use it for C.elegans, zebrafish and single cells."

Prof. Hendrik Dietz
TU Munich,
Germany

"VAHEAT allows precise and fast temperature control in our TIRF measurements where we are investigating switchable DNA origami mechanisms."

VAHEAT white paper

Icha, J., Böning, D., Türschmann, P., Precise and Dynamic Temperature Control in High-Resolution Microscopy with VAHEAT.
Microscopy Today, 30(1), 34-41 (2022).

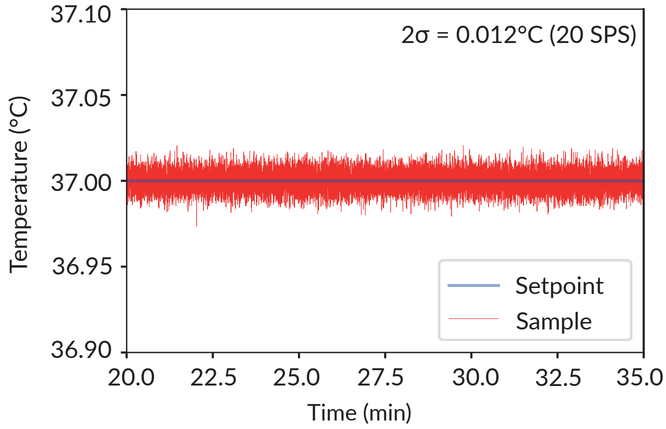
- Device description and characterization
- Application examples
- Please cite when using VAHEAT

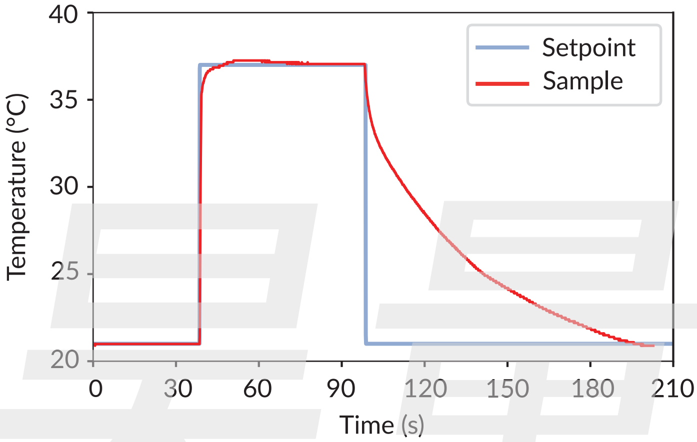
DOWNLOAD HERE

Performance

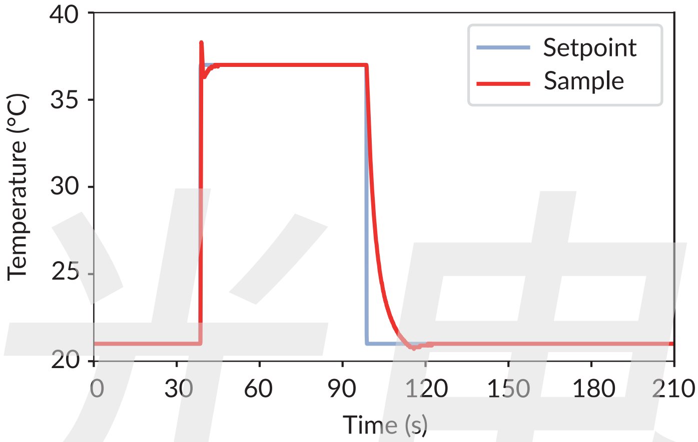
Fast Temperature Response

The feedback driven heating element directly integrated into the smart substrate enables extremely fast temperature variations with up to 100 °C/s providing unprecedented temperature stability over short and long time scales. The temperature probe measures the sample temperature 80×/s and heating is adjusted accordingly.
The feedback loop between temperature sensing and heating is controlled by proportional–integral–derivative (PID) algorithm. The default values of P, I and D terms can be adjusted for large sample volumes and rapid heating scenarios (see manual).





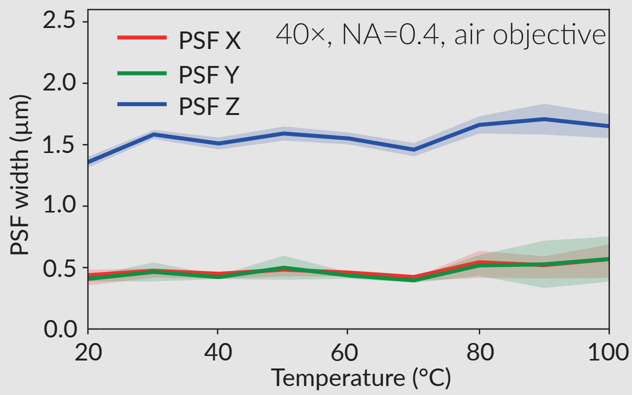
Temperature response of a Smart Substrate with a thermal load of 200 µl of water.



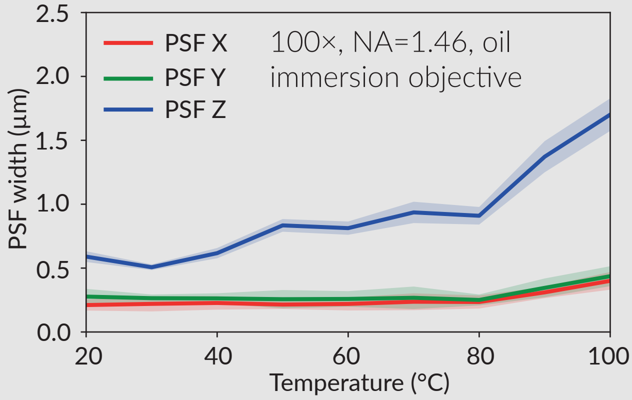
Temperature response of a Smart Substrate without additional thermal load.

Excellent Image Quality

The Point-Spread-Function (PSF) represents the image of a point-like object acquired with a microscope. Its geometry is a direct measure for the image quality. We imaged subresolution fluorescent beads with VAHEAT to record the PSF at different temperatures.

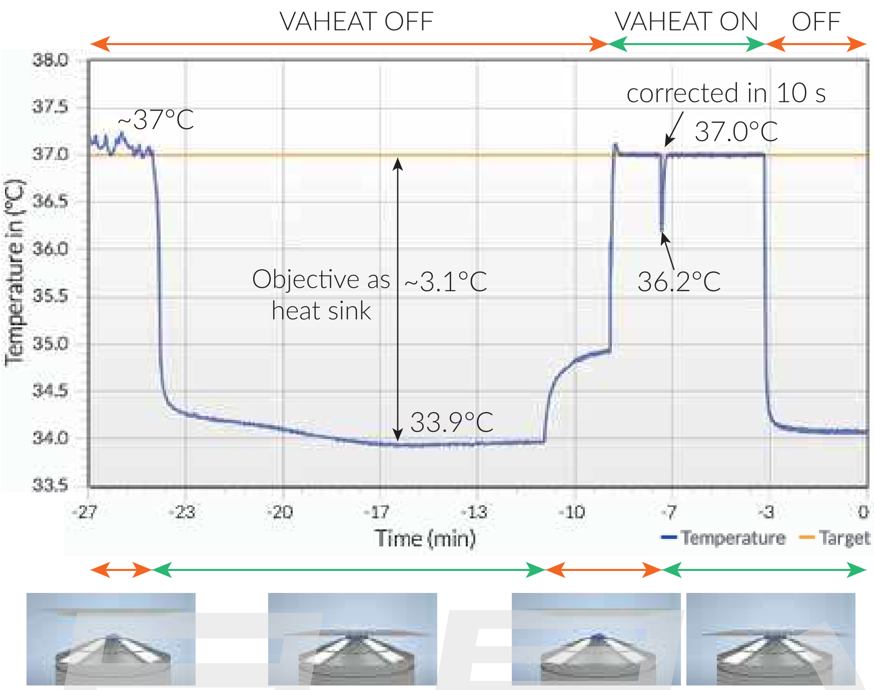


- No image alteration for air objectives for temperatures ranging from 20 °C to 100 °C
- No change in image quality for immersion and air objectives in lateral direction within a temperature range between 20°C and 80°C
- Minimal axial PSF size increase (30%) for immersion objectives for temperatures between 20 °C and 80 °C caused by a decreasing refractive index of the immersion oil.



Performance

Removing Temperature Gradients



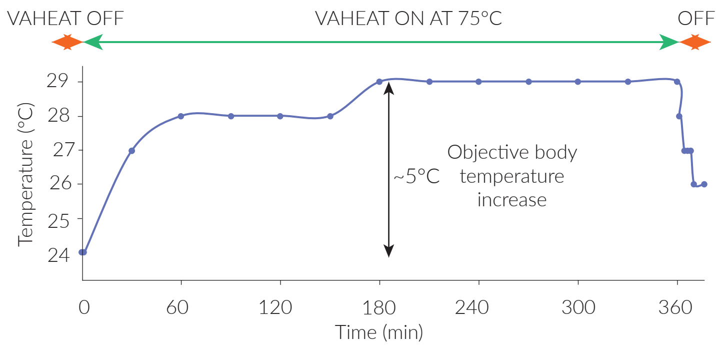
Conventional incubator with low temperature precision

VAHEAT mounted on an inverted microscope inside an incubation chamber.

VAHEAT effectively neutralizes the heat sink effect coming from the immersion objective. In this experiment, we demonstrated a 3.1°C gradient even after 4 hours of environmental enclosure equlibration at 37°C. VAHEAT works so well because it measures and maintains temperature exactly where your sample is placed.

No excessive heating of optical components

Running VAHEAT at 75°C for 6 hours heats up the body of an immersion objective only by 5 °C. Very localized heating reduces the overall heat load transferred into the setup and leads to tolerable warming up of the objective and no thermal drift. This makes experiments with immersion oil objectives possible at temperatures higher than ever before. Do you want to do single molecule TIRF imaging with a protein from a thermophilic microorganism?
Not a problem with VAHEAT!



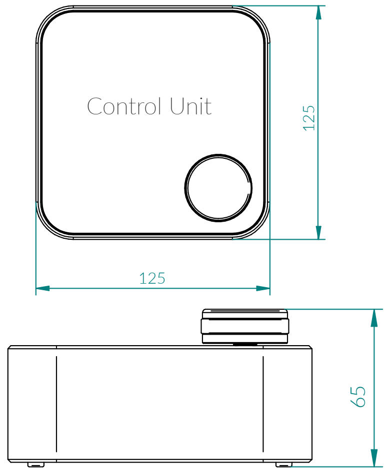
Temperature Profiles

User defined temperature protocols allow for precise manipulation of the sample. VAHEAT can do all this, even run a PCR reaction.

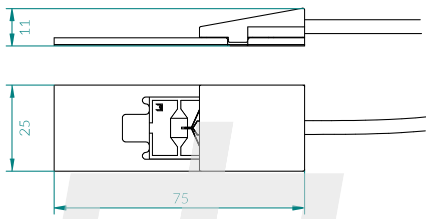
- Deactivating temperature sensitive alleles of proteins
- Inflicting a precisely defined heat shock on cells
- Measuring temperature dependence of a given process over a wide range of temperatures
- Oscillating around a critical temperature of a phase transition

Technical Specifications

Specifications VAHEAT		
Version	**Standard Range**	**Extended Range**
Technical Specifications		
Max. Heating Power	< 2.5 W	<5.0 W
Sample Temperature	RT – 105 °C	RT – 200 °C
Relative Temperature Precision	+/- 0.1 °C	
Operating Modes	Auto, Direct, Shock, Profile	
General and Environmental Specifications		
Qualifications	CE, FCC, RoHS compliant	
DC Input	24 V DC, <0.75 A	
Power Consumption	<10 W	< 18 W
Remote Control	JSON via USB	
Operating Temperature Range	15 – 40 °C	
Storage Temperature Range	-10 – 60 °C	
Operating Relative Humidity	non condensing, <90%	
Dimensions Control Unit	125 × 65 × 125 mm³ (W × H × D)	
Dimensions Microscope Adapter	75 × 2.5 × 25 mm³ (W × H × D)	

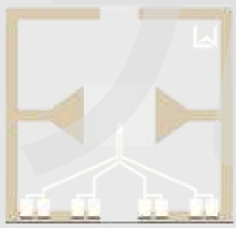


Universal Microscope Adapter



Smart Substrates

- transparent heating element
- calibrated temperature probe (R25, TKR parameters)
- top surface is glass only and can be functionalized
- multi-use disposable (typical 4-5 uses per substrate)
- ultra-low fluorescence glass suited for SR microscopy



SmS | SmS-L
- Standard smart substrates for high precision measurements
- also large area version available

SmS-D
- enhanced lifetime
- compatible with any immersion liquid

SmS-E
- suitabe for imaging at extreme temperatures
- resistant towards heat-induced bending

Propert/Type	SmS	SmS-D	SmS-L	SmS-LD	SmS-E
Temperature	0 - 105 °C				0 - 205 °C
Size	18 x 18 mm²				
Thickness	170 µm (#1.5 H)				500 µm
Heated area	5 x 5 mm²		10 x 12 mm²		5 x 5 mm²
Immersion medium	oil	oil, water,glycerol	oil	oil, water,glycerol	none
Compatible reservoirs		R5	R12, R12S, FC, FC-S		R5

Reservoirs

- for liquid samples
- made from biocompatible silicone for live cell studies

Property/Type	R5	R12	R12S	FC	FC-S
Max. volume	600 µL	800 µL	2 x 350 µL	60 µL	2 x 20 µL
Height	6.5 mm				
Cap available	Yes			Closed	
Description	Open reservoir			Microfluidic flow cell	

Standard Smart Substrate (SmS) with reservoir (R5)

Contact

BOOK YOUR DEMO TODAY!

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