NanThermix

Plug-and-play nanoscale thermal control for the life sciences

DHT IS THE ONLY TOOL WHICH COMBINES THERMAL MEASUREMENT AND STIMULATION IN ONE PARTICLE

- An elegant solution combining glass capillary and a single diamond crystal, DHTallows one to reliably induce desired level of ultra-local heating and precisely measure temperature changes at the nanoscale.
- Thermosensitive silicon-vacancy (SiV) color centers in diamond enable purely optical temperature readout in the near-infrared range. No bulky microwave circuits needed.
- Unprecedented temporal and spatial resolution allows you to implements arbitrary thermal protocols and apply them to a variety of solid-state and biological systems, from ion channels to multicellular organoids.

EASY-TO-USE SYSTEM

Thanks to the fiber-coupled optical scheme and an intuitive software interface, DHT can be quickly set up to operate in any lab.

01. Main features

PERFORM STABLE AND RELIABLE MEASUREMENTS

Thanks to the properties of diamond, the DHT has infinite photostability and is insensitive to the effects of the environment (pH, magnetic or electric field), making your temperature measurements fully reliable.

CONTROL THE FASTEST PROCESSES

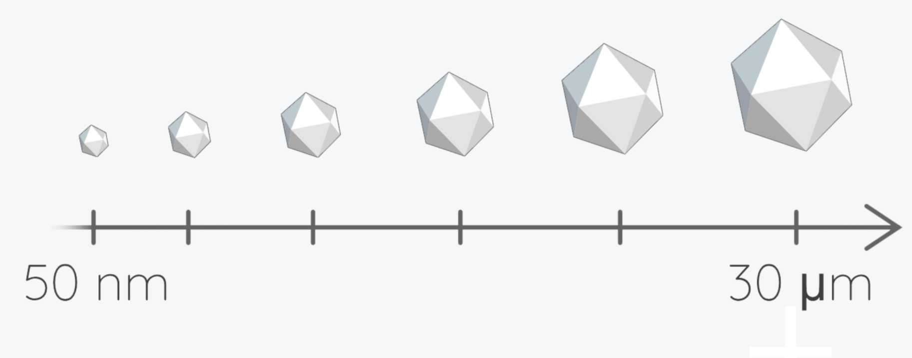
DHT allows you to define custom ultrafast temperature protocols, with millisecond steps in the detection mode and microsecond for the heating.

WORK IN THE BIOLOGICAL TRANSPARENT WINDOW

The fluorescence of the SiV-centers lies in the near-infrared, so you can use the DHT with any sensitive biological samples.

CHOOSE OPTIMAL DIAMONDS

Wide range of diamond particle sizes available, from 50 nm up to hundreds of microns.

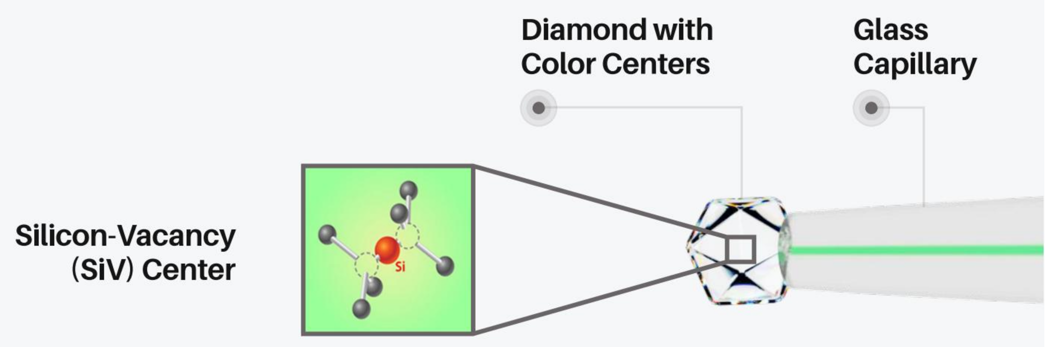


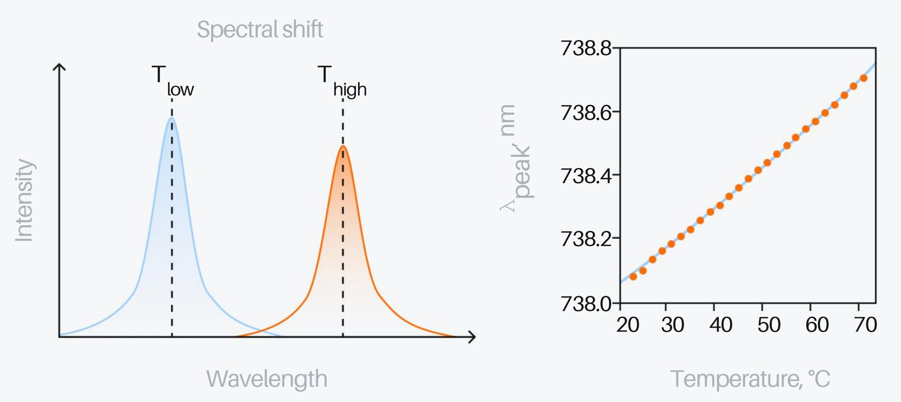
02. Operation principle of the Diamond Heater-Thermometer (DHT)

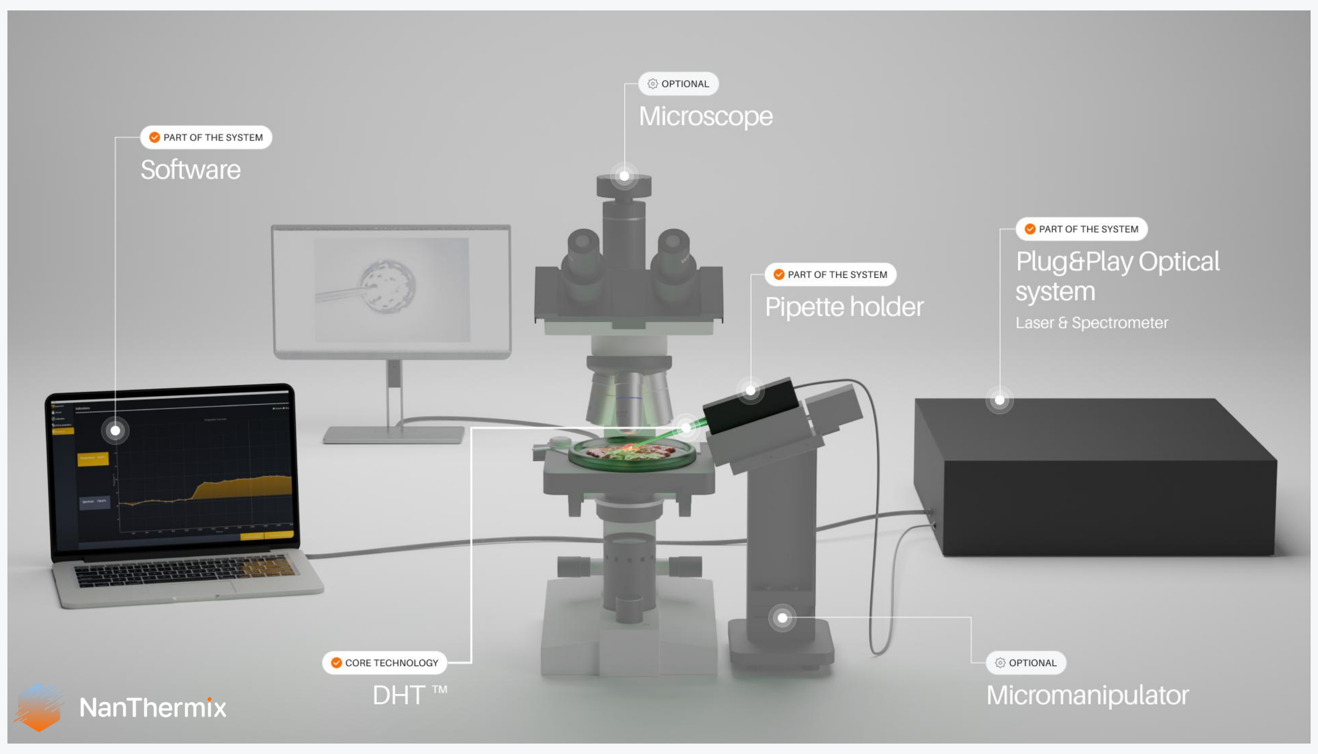
The DHT technology is based on a single engineered diamond micro- or nanoparticle placed on the tip of a pulled glass pipette. This diamond particle has two main features: 1) It contains atomic defects in its crystalline lattice called silicon-vacancy (SiV) color centers, which act as quantum sensors and enable all-optical fluorescence-based thermometry. 2) It possesses inclusions of amorphous carbon at its intercrystalline boundaries, making it an efficient light absorber and turning it into an ultra-local nanoscale heat source.

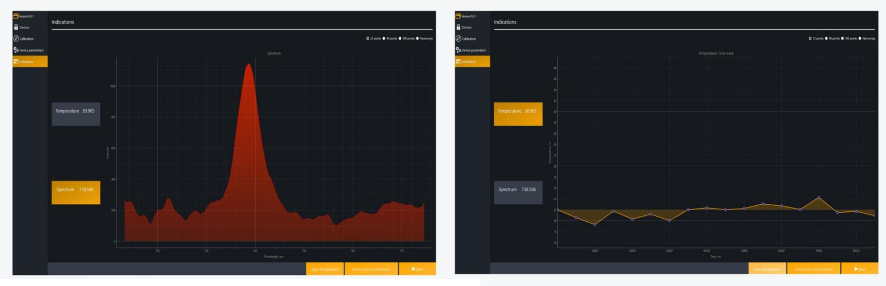
SiV color centers absorb visible light and produce a fluorescence peak at 738 nm. The exact position of this peak strongly depends on local temperature and does not depend on other environmental factors (pH, magnetic or electric field), due to unique properties of the SiV centers. This phenomenon is used in the DHT to measure local real-time temperature. The diamond particle is illuminated with a laser, and the position of the SiV spectral peak is registered by a spectrometer, which is automatically converted to the actual temperature.

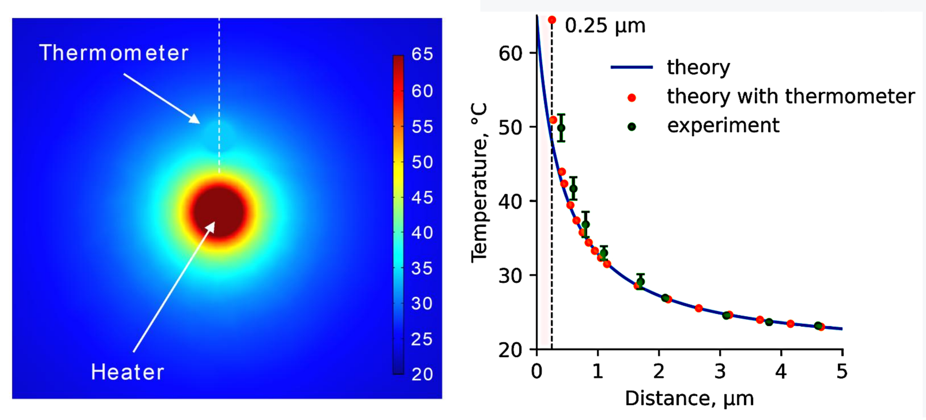
Meanwhile, it can still serve as a thermometer, providing accurate feedback about the actual heat pulse applied to the system. This is a crucial advantage of the DHT system, combining thermal monitoring and stimulation in a single nanoscale solid-state systems and liquids, making it stand out in comparison to all existing techniques.







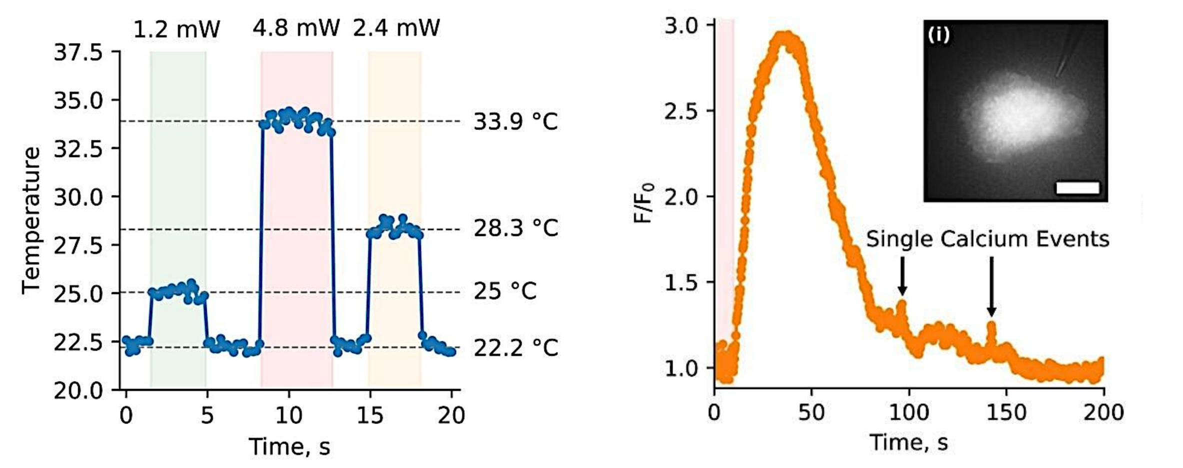




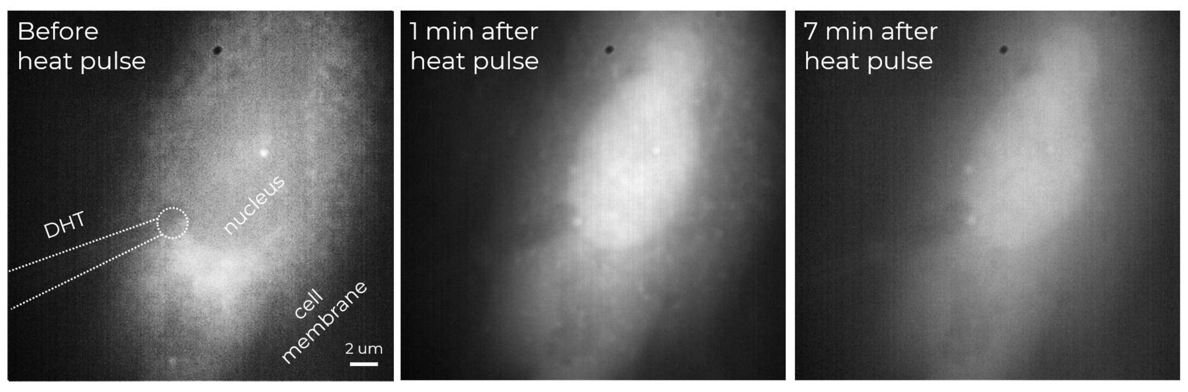
Relaxation time ≈10 µs → 100 kHz modulation bandwidth

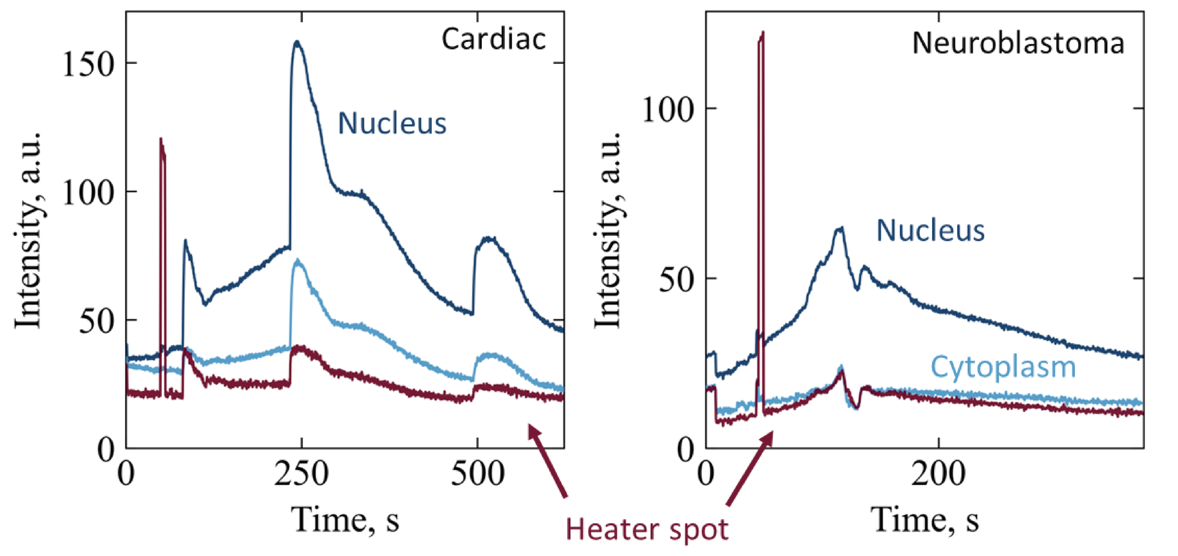
1 Scientific Reports 11, 14228 (2021), A new approach to precise mapping of local temperature fields in submicrometer aqueous volumes.
2 Nanomaterials, 13, 1 (2022), Heat release by isolated mouse brain mitochondria detected with diamond thermometer.
3 Scientific Reports 13 (1), 8546 (2023), A new method for ultra-local thermal control of a single living cell.

03. Thermal release of Ca^{2+}

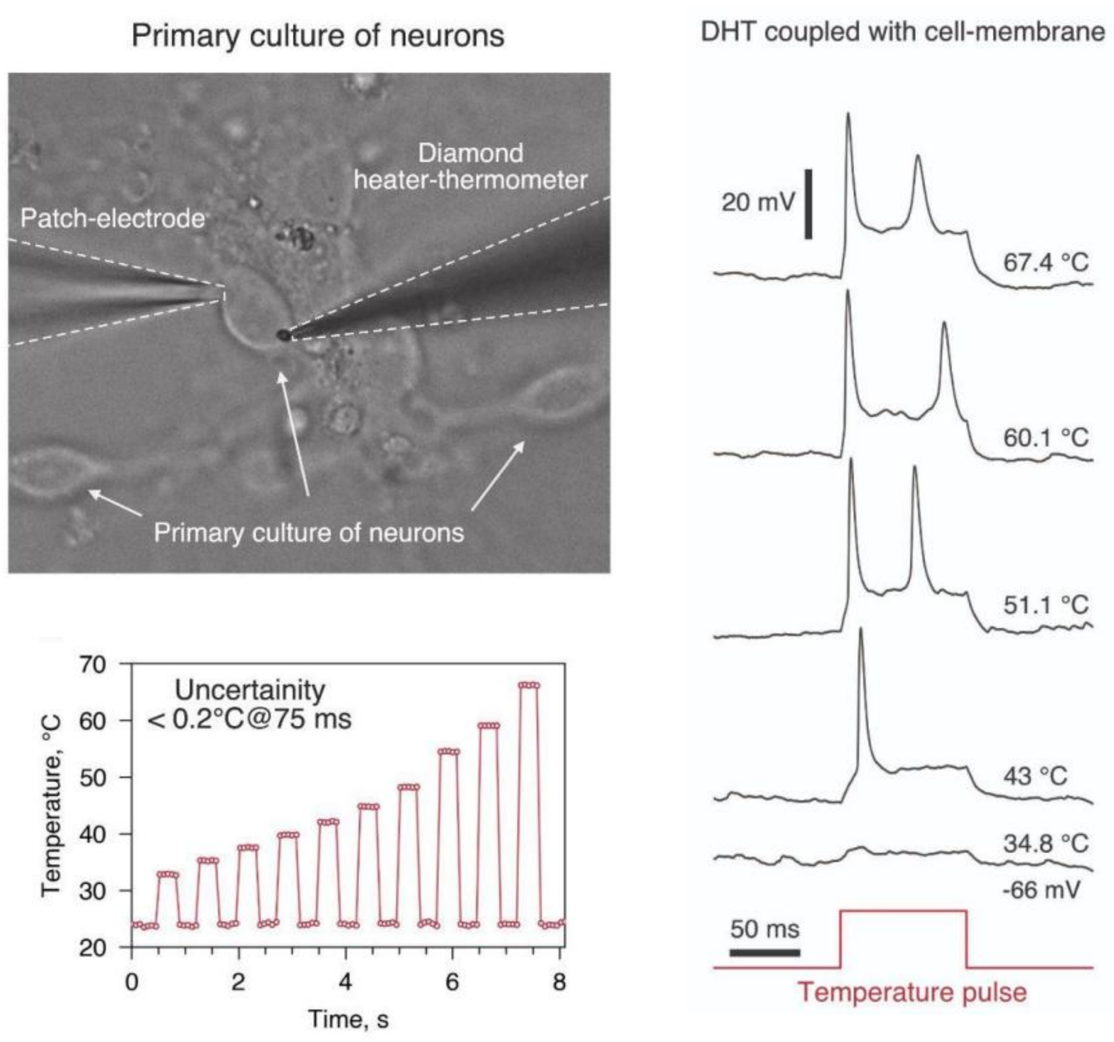


Spatial and temporal distribution of Ca^{2+} in living cells after ultra-local heat pulse (Fluo4 staining)



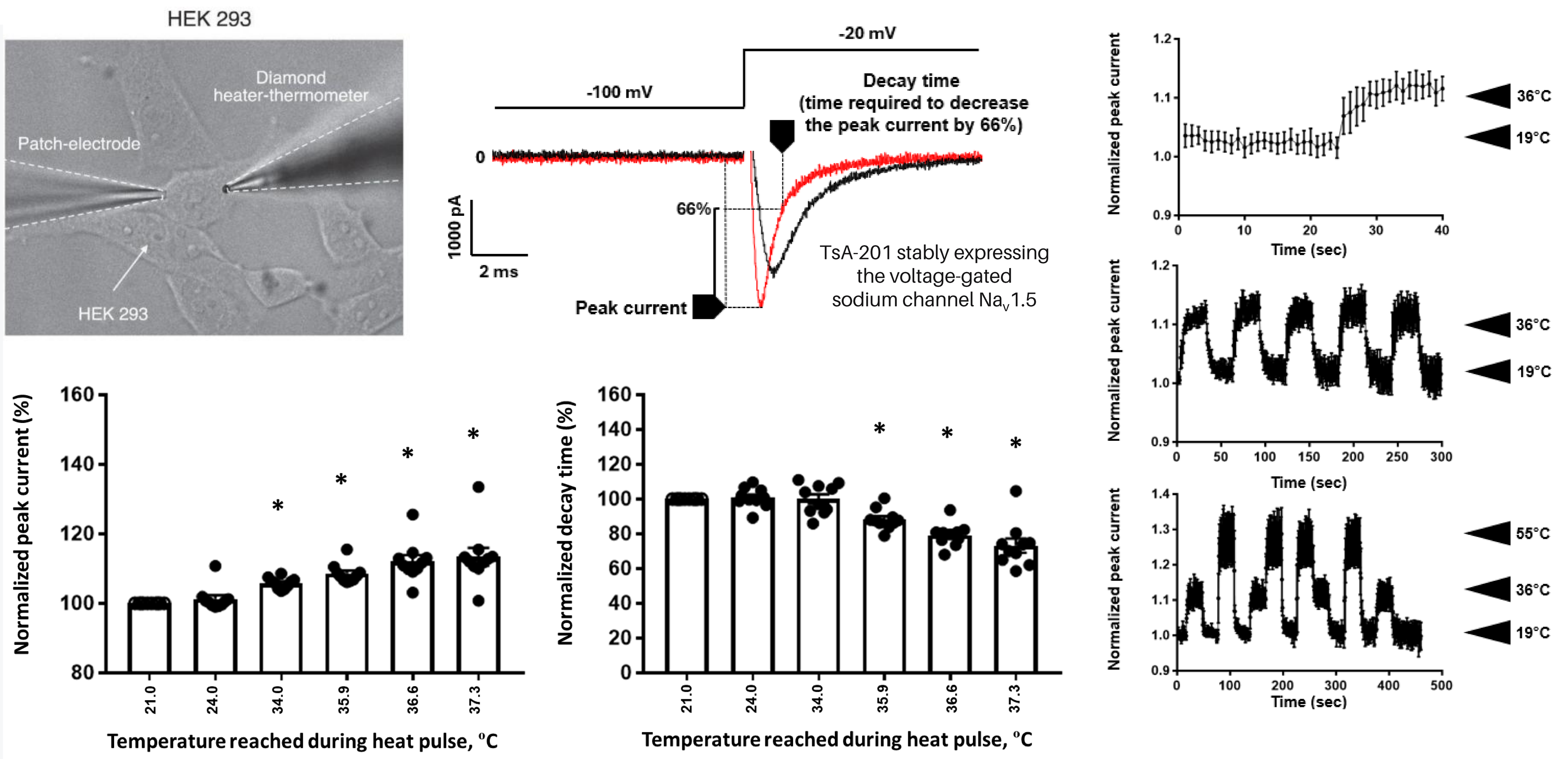


04. Rapid Neurostimulation



Romshin, et al., Rapid neurostimulation at the micron scale with an optically controlled thermal-capture technique, Biomaterials Science (2024), doi.org/10.1039/D4BM01114G

05. Thermal modulation of ion channels



Rougier et al., All-optical Diamond Heater-Thermometer enables versatile and reliable thermal modulation of ion channels at the single-cell level, bioRxiv (2025), doi.org/10.1101/2025.06.03.657561

Ability to thermally stimulate a living cell cell opens up new horizons in biological applications. We are excited to be your trusted partner in catalyzing your next breakthrough discovery.

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