DENS solutions

DATASHEET

Lightning

In Situ TEM **Heating & Biasing Solution**

The Lightning In Situ TEM Heating and/or Biasing Series allows to observe real-time dynamics of your specimen under a controllable electrical and thermal environment while maintaining the atomic imaging resolution provided by the TEM. This versatile system greatly expands the application space of your TEM, providing the unique possibility to link the processing conditions with the structure, properties and performances of your materials and devices under heating, biasing or heating and biasing stimuli.

Potential applications among others include heat treatment of metals, ceramics, low dimensional materials and polymers, studies of transport properties and degradation in solid state batteries, fuel cells and solar cells in the field of sustainable energy conversion and storage, electric field induced phenomena in ferroelectrics, resistive switching and phase-changing processes in the future non-volatile memory, electrical characterization of semiconductors devices like diodes, MOSFETs and LEDs.

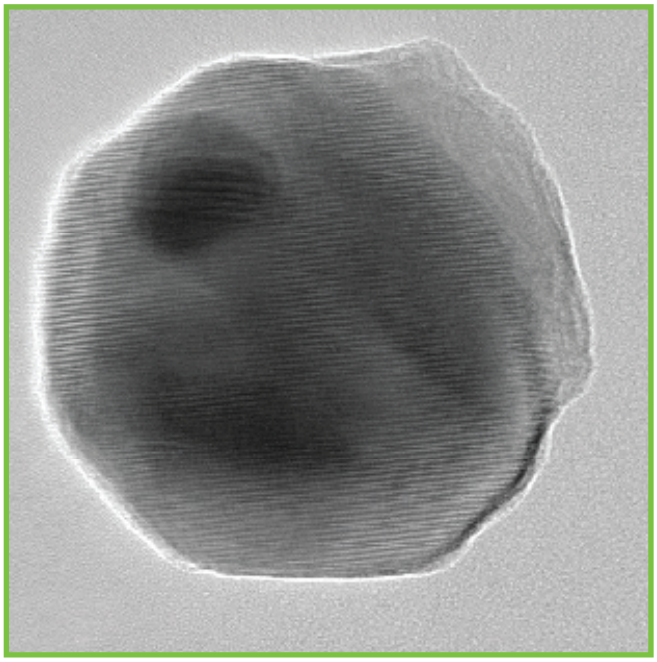

Fig. 1. BNT - ST (220 kV/cm, 800 °C)

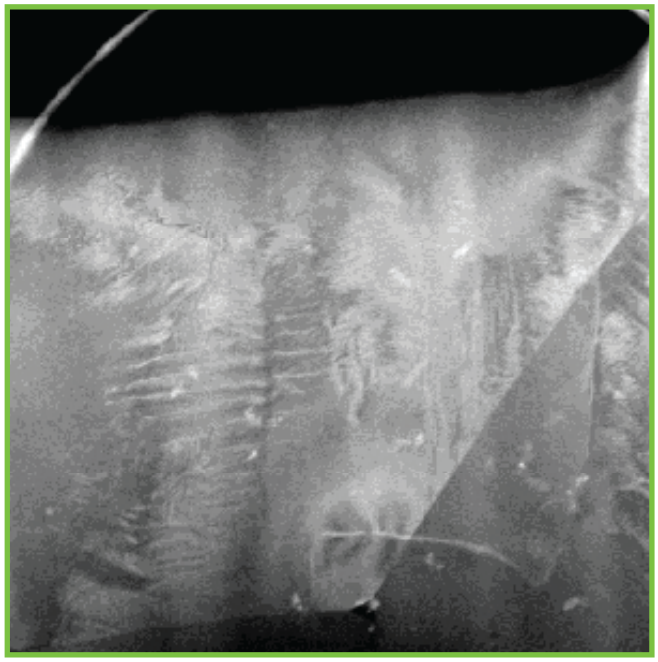

Fig. 2. PZT (50 kV/cm, RT)

Nano-Chip	Lightning HB+
Heater material	Chemically inert encapsulated metal
Heating range	RT - 1,300 °C
Heating & Biasing range	RT - 900 °C
Temperature control mode	Closed 4-point probe feedback loop
Temperature stability	± 0,005 °C
Temperature accuracy	≥ 95 %
Temperature uniformity	≥ 99.5 %
Z-displacement T ≤ 500°C	≤ 200 nm
Sample preparation methods	Drop casting, thin film deposition, 2D materials transfer and FIB
Sample displacement	≤ 50 nm for ΔT = 600 °C
Detectable current range*	1 pA to 100 mA
Membrane Breakdown voltage @ RT (@ 900 °C)	≥ 150 V (≥ 150 V)
Attainable E-fields @ RT (@ 900 °C)	≥ 300 kV/cm (≥ 300 kV/cm)
Transparent area	up to 100 Hz

** Depending on the Source Measuring Unit*

Features and benefits

Application space

The largest temperature and biasing range (separate or combined), the highest current sensitivity and the largest mechanical tilt range enabled by the Lightning solution provide a powerful tool for observing any sample dynamics.

Sample stability

The improved Nano-Chip design offers the highest in plane and focus stability during heating/cooling and/or biasing, keeping the sample in focus and in the line of sight. This prevents the user from missing any important event and achieve the highest resolution for imaging and spectroscopy.

Temperature control

The 4-point probe temperature control, optimized Nano-Chip design and two-step calibration process ensure accurate and reliable temperature control over the entire temperature range.

Biasing control

A close-loop resistive feedback control assures no disturbances to the sample's temperature coming biasing (e.g. Joule heating). The design of the biasing electrodes and the quality of the SiN membrane is responsible for extremely low leakage currents, allowing the highest possible current sensitivity.

Sample preparation

The Nano-Chips are optimized for the use of different types of samples. Together with dedicated procedures and a custom-designed stub for FIB lamellas, it removes any bottlenecks in the sample preparation and allows the user to focus on the situ TEM experiments.

	JEOL	Thermo Fisher Scientific
Polepiece compatibility	URP, FHP, SAP, HRP, HCP, WGP	C-TWIN, TWIN, X-TWIN, S-TWIN
Attainable resolution*	≤ 0.6 Å	
Drift rate*	≤ 0.5 nm/min	
EDS compatibility**	Yes	
Number of electrical contacts	8	6
Alpha tilt range***	URP, FHP ≥ ± 8 deg HRP, WGP ≥ ± 20 deg	≥ ± 22 deg
Beta tilt range***	URP, FHP ≥ 15 deg HRP, WGP ≥ ± 25 deg	≥ ± 25 deg

**The listed specifications are dependent on the microscope configuration and its performance.*

*** Depends on the EDS detector configuration.*

**** Tilt ranges are dependent on the exact pole piece gap, microscope configuration and EDX detector used and might vary from the listed specifications.*