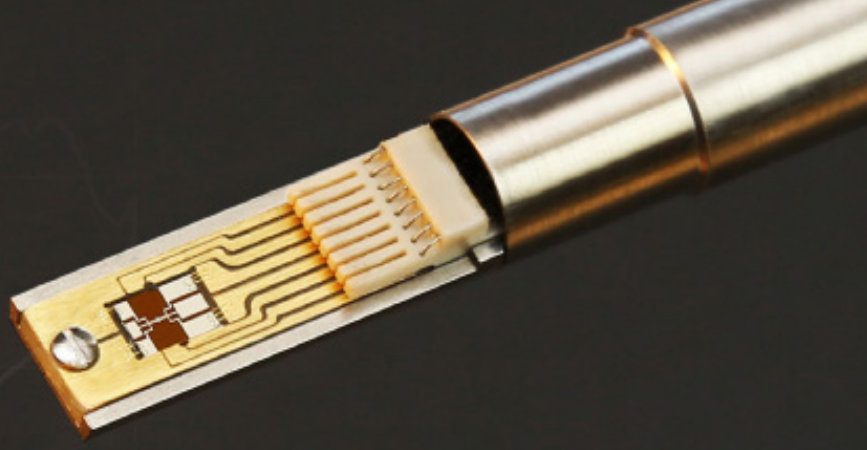
HUMMINGBIRD SCIENTIFIC



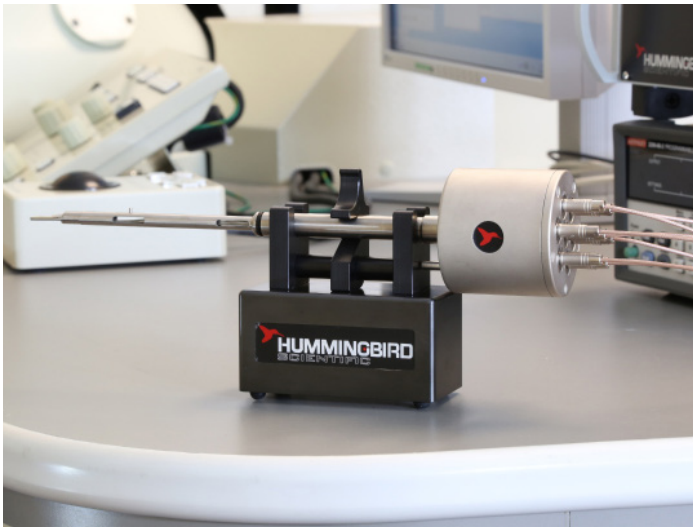
Electrical Biasing

Technical Specs

	1600 Series
Tilt Range	±45° depending on microscope and pole piece
Number of Electrical Contacts	6, 8, or 9 *
Contact Type	Flexible wirebond contacts or fixed spring contact
Carrier	Removable Sample Carrier
Carrier Compatibility	Any Standard TEM Sample Supports
Sample Size	Fits up to 3 x 6 mm samples
Wiring	Standard or low-noise shielded
TEM Compatibility	TFS, JEOL, Hitachi, Zeiss, Nion

** Contact us for Custom Configurations*

Overview

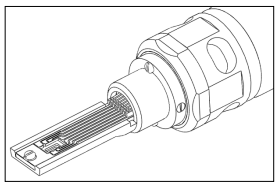


Hummingbird Scientific's in-situ electrical biasing holder allows researchers to investigate the electrical response of materials inside the transmission electron microscope. The standard biasing holder has a removable chip carrier that accommodates a wide range of TEM sample geometries. This design allows convenient sample preparation outside the holder and is compatible with all of Hummingbird Scientific's membrane substrates. Low-noise wiring ensures accurate measurements.

Sample Applications:

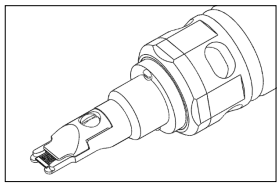
- Correlating the electrical properties of nanoscale material and microstructures
- Studying the relationship between material defect populations and electrical responses
- Electromigration studies
- Operating microelectomechanical systems (MEMS) based mechanical testing devices
- *In-situ* testing of solid-state energy devices

Sample Contact Options



Board Contact (Type I)

This contact configuration features a reusable removable sample board carrier. As a result, researchers can prepare the sample directly on the board, which is then placed into the holder tip for a quick connection to an electrical connector with up to 8 contacts. Samples up to 3 x 6mm in size can be mounted on the standard board carrier. Electrical connections between the chip and the carrier are made using ultra-sonic wire bonding, allowing for at flexible connection between the contacts and the chip. Contact us for custom board configurations.



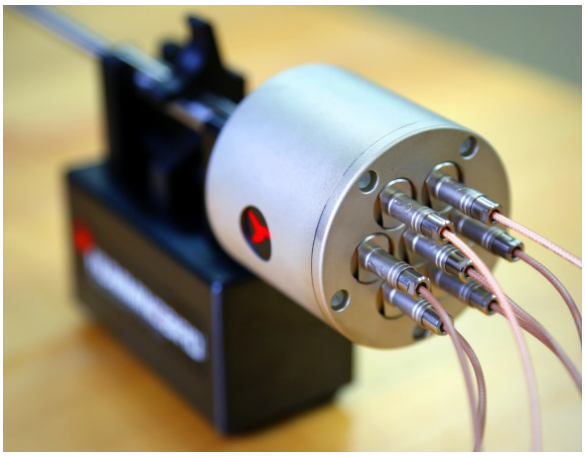
Direct Chip Contact (Type II)

This contact configuration features a single chip that is directly inserted into the holder via a proprietary connector with up to 9 electrical contacts. The sample is prepared directly on the standard sample substrate chip. Pre-patterned metal leads lead up to the electron transparent membrane onto which the sample is built. Contact us for more information on electrical biasing and sample heating chips for this holder.

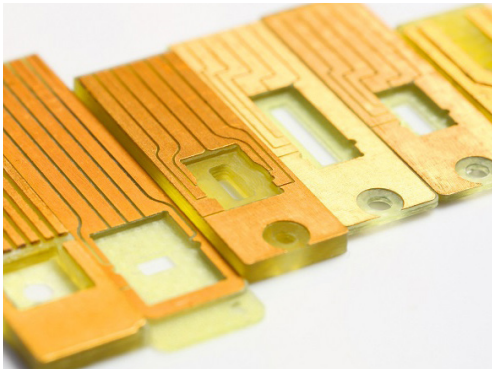
Options

The 1600-series holder features a range of special options:

- Custom-designed sample carriers to fit almost any TEM sample geometry
- Low-noise, individually-shielded cabling option for pA-range current measurements.
- Keithley 2400 SMU



Accessories



Accessories available for your electrical biasing holder:

- Specialized Sample Substrate Chips
- Vacuum Tip Cover
- Custom Chip Carriers
- Keithley 2400 SMU

Available For

THERMO FISHER SCIENTIFIC TEM

HITACHI TEM

NION TEM

JEOL TEM

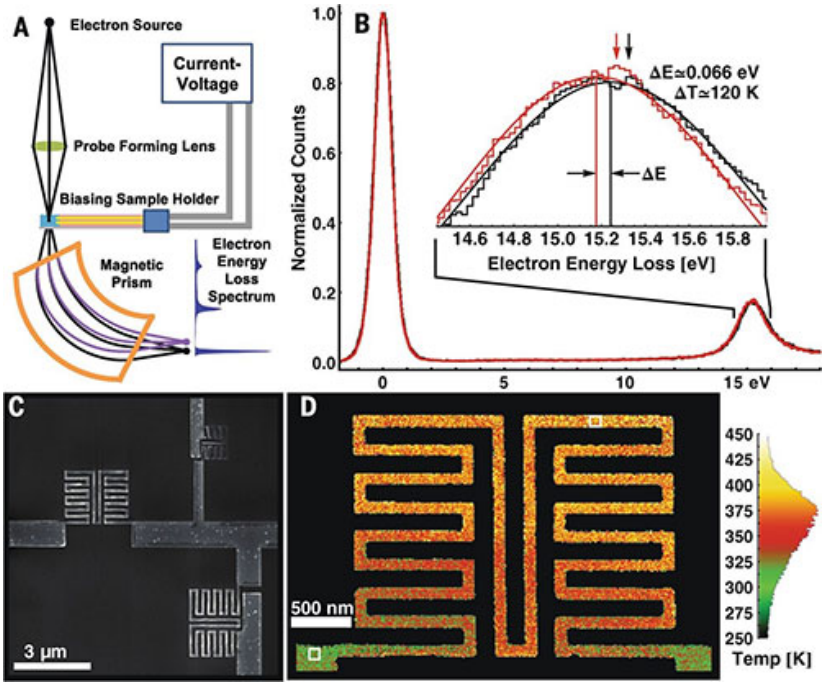
ZEISS TEM

Featured Research

Temperature mapping on the nanoscale

Microelectronic devices can be simultaneously seen and tested with a biasing holder—taking advantage of the TEM's analytical toolbox, like in this example, where the in-situ TEM biasing holder and EELS are used to capture changes in temperature. A team led by UCLA demonstrate a noncontact thermometric technique to measure bulk temperatures with nanometer-scale spatial resolution using plasmons.

Reference: B.C. Regan et al. Nanoscale temperature mapping in operating microelectronic devices. *Science* (2015).



Joule heating and EELS spectrum of Al device. Image copyright © 2016 by the American Association for the Advancement of Science

Selected Publications

Saurabh Gupta, Sandra Stangebye, Katherine Jungjohann, Brad Boyce, Ting Zhu, Josh Kachera, and Olivier N. Pierron. **"In situ TEM measurement of activation volume in ultrafine grained gold,"** *Nanoscale* (2020)

William A. Hubbard, Matthew Mecklenburg, Jared J. Lodico, Yueyun Chen, Xin Yi Ling, Roshni Patil, W. Andrew Kessel, Graydon J. K. Flatt, Ho Leung Chan, Bozo Vareskic, Gurleen Bal, Brian Zutter, and B. C. Regan. **"Electron-Transparent Thermoelectric Coolers Demonstrated with Nanoparticle and Condensation Thermometry,"** *ACS Nano* (2020)

Paul Masih Das and Marija Drndić, **"In Situ 2D MoS2 Field-Effect Transistors with an Electron Beam Gate,"** *ACS Nano* (2020)

June W. Lau, Karl B. Schliep, Michael B. Katz, Vikrant J. Gokhale, Jason J. Gorman, Chunguang Jing, Ao Liu, Yubin Zhao, Eric Montgomery, Hyeokmin Choe, Wade Rush, Alexei Kanareykin, Xuewen Fu, and Yimei Zhu, **"Laser-free GHz stroboscopic transmission electron microscope: Components, system integration, and practical considerations for pump–probe measurements,"** *Review of Scientific Instruments* (2020)

Brian Zutter, Hyunseok Kim, William Hubbard, Dingkun Ren, Matthew Mecklenburg, Diana Huffaker, and B. C. Regan. **"Mapping Charge Recombination and the Effect of Point Defect Insertion in Gallium Arsenide Nanowire Heterojunctions".,** *arXiv:2010.05140* (2020)

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