Model 1070
NanoClean

Effectively cleans specimens, holders, grids,
and bulk objects for electron microscopy
and many other applications

FISCHIONE INSTRUMENTS

EXCELLENCE...MAGNIFIED

Model 1070 NanoClean

- *Multifunctional – Simultaneously cleans specimens, specimen holders, and stubs.*
- *Inductively coupled, downstream plasma for optimal performance.*
- *Sputter-free – No change to elemental composition or structural characteristics.*
- *Accepts two EM specimen holders.*
- *Compatible with side-entry holders for all commercial TEMs, STEMs, and SEMs.*
- *Accommodates large objects.*
- *Ideal for surface science techniques.*
- *Multiple gas inlets with mixing capabilities.*
- *High frequency power with automatic matching network.*
- *Oil-free vacuum system.*
- *Simple setup with touchscreen interface.*
- *Handy for evacuating vacuum storage containers.*

Model 1070 NanoClean
removes contamination

Electron microscopy requires clean specimens and holders

Clean, well prepared specimens are imperative for imaging and microanalysis in electron microscopy.

Transmission electron microscopy (TEM) requires that specimens be prepared without altering their microstructure or composition.

Modern electron microscopes with high brightness electron sources such as LaB_6 filaments and field emission guns (FEG) use a small electron probe with high beam current for microanalysis, yielding high-resolution images as well as enhanced analytical data. As probe size decreases and beam current density increases, specimens tend to become easily contaminated. As a result, the quality of the specimen and the cleanliness of both the specimen and the specimen holder are more important than ever.

Contamination typically comes from several sources: inadvertent touching of specimens or specimen holders, electron microscope column contamination, and adhesives or solvents used in the preparation process. Even when great care is taken to clean the specimen, standard cleaning methods are often not completely successful.

Model 1070 NanoClean

Clean large objects and grids

In addition to traditional electron microscopy applications, many other objects can benefit from plasma processing. Larger objects, such as pieces of semiconductor wafers or SEM/AFM/SIMS holders, can also be cleaned.

For biological TEM applications, grids can be subjected to the plasma to promote hydrophilic wetting.

Model 1070 NanoClean for electron microscopy applications

The Model 1070 cleans specimens and holders immediately before they are inserted into an electron microscope. Plasma cleaning both removes existing carbonaceous debris from the specimen and prevents contamination during imaging and analysis.

A low-energy, inductively coupled, high frequency (HF), downstream plasma effectively cleans the specimen surface without changing its elemental composition or structural characteristics. Highly contaminated specimens can be cleaned in two minutes or less.

The Model 1070 readily accepts one or two side-entry specimen holders for all commercial TEMs and STEMs, and can accept bulk specimens for cleaning before conducting scanning electron microscopy (SEM) or surface science analysis.

Plasma cleaning

In a nonequilibrium, high frequency plasma, free electrons are accelerated to high velocities by an oscillating electromagnetic field and collide with gas atoms, forming ions and sustaining the plasma. The plasma products impinge upon surfaces with energies of less than 12eV, which is below the specimen's sputtering threshold.

Cleaning is solely by the chemical reaction between radicals from the plasma and carbonaceous material on the specimen and specimen holder.

An oxygen plasma is highly effective in removing organic (hydrocarbon) contamination. The reactions yield H_2O, CO, and CO_2 which are evacuated by the vacuum system.

A mixture of 25% oxygen and 75% argon is generally recommended. Other gases or mixtures can also be used.

Clean specimens and holders

A wide variety of materials prepared by a number of techniques can be plasma cleaned by the Model 1070 and yield identical results – no contamination of the specimen under the electron beam.

The specimen holder is inserted through a port into the plasma chamber. The port contains a vacuum-sealing surface compatible with the specimen holder's o-ring.

The chamber is configured to accept one or two specimen holder ports. Ports are easily interchangeable without tools in as little as 10 seconds. Ports are available for side-entry specimen holders for FEI/Philips, Hitachi, JEOL, and Carl Zeiss microscopes.

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Clean specimens and holders *(continued)*

For specimens containing significant amounts of carbon or those mounted onto carbon support grids, shielded specimen holder ports are available to optimize the cleaning rate of the plasma.

Typical TEM specimen holder port

Imaging can proceed with confidence

Plasma cleaning is an essential final step in the preparation of specimens for electron microscopy. Using the Model 1070 NanoClean ensures confidence that organic contamination will not interfere with imaging or analysis, even during fine probe microanalysis for extended periods.

Plasma cleaning results: SEM (EDX)

The benefits of plasma cleaning are not only for TEM but also for bulk specimens, which can be readily introduced through the chamber's top port. Specimens for SEM and surface analysis can be cleaned as well as specimen holders, aperture strips, tweezers, specimen clamping rings, and anything else that can be placed into the plasma chamber.

Plasma chamber

The plasma is generated in a cylindrical chamber made of quartz and stainless steel. A high frequency antenna, located outside the chamber, inductively couples the oscillating electromagnetic power to the process gas contained in the chamber. No components are located within the chamber other than the object that is being cleaned. Sophisticated gas dynamics associated with the downstream plasma ensure that the plasma is evenly distributed within the chamber to clean the specimen with negligible heating.

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Plasma chamber *(continued)*

Receptacles on the front surface of the chamber can accept two ports for standard EM specimen holders. A view port provides the ability to observe the inside of the chamber. A lid on top of the chamber allows larger objects to be placed into the plasma.

Chamber lid closed

Chamber lid open

Vacuum system and load lock

An oil-free vacuum system is essential to prevent contamination. The vacuum system for the Model 1070 consists of a turbomolecular drag pump and a multistage diaphragm pump, an ideal combination for establishing suitable vacuum characteristics to activate and sustain the plasma. The vacuum level is measured by a Pirani gauge.

The chamber includes a load lock for rapid specimen exchange which allows plasma cleaning to begin almost immediately after a specimen is inserted. An electronically actuated gate valve isolates the plasma chamber from the vacuum system. Pump down time for the chamber is less than 50 seconds. Also, the chamber can be vented within 5 seconds after the conclusion of plasma processing. These features make the Model 1070 ideal for high throughput applications.

The Model 1070 can also be used to evacuate individual specimen holder vacuum storage containers and cyrotransfer TEM specimen holder dewars.

A port plug inserted into the specimen holder port seals the chamber under vacuum when the instrument is not in use.

Power supply

The high frequency (13.56 MHz) oscillating power supply is used to initiate and sustain a low-energy, inductively coupled plasma (ICP). An ICP is ideal for microscopy applications since it delivers ions with energy low enough that the specimen's properties are not altered.

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Power supply *(continued)*

An automatic matching network ensures that the high frequency power is effectively coupled to the plasma and the delivered power is suited for the application. The matching network regulates plasma power for a variety of conditions, objects to be processed, or gases employed. It also guarantees plasma compatibility with specimen holders produced for diverse EMs.

Effective shielding prevents high frequency interference and fully complies with FCC guidelines.

Process gas

The Model 1070 contains three mass flow controllers and is designed to accept multiple gases. Typically, the time-proven gas mixture of 25% oxygen and 75% argon is connected to one of the gas inlets. The Model 1070 is fitted with two additional gas inlets which accept gas supplies that can be blended using the Model 1070's internal mass flow technology.

Instrument controls and display

An easy-to-use touchscreen embedded module allows the user to control individual instrument functions such as delivered power, chamber pressure, gas mixture, and process time.

For dedicated cleaning of EM specimens and holders, the Model 1070 includes a recipe that yields optimal plasma processing conditions. All the user needs to do is insert the EM specimen holder into the specimen holder port and establish the process time. The instrument automatically controls the vacuum, supplies the appropriate power and gas flow, and energizes the plasma.

Recipes are stored for applications such as enhancing the hydrophilic properties of biological support grids. Custom recipes to set up a unique set of operating conditions can be created and stored by using the touchscreen.

The display provides a real-time representation of the instrument's key parameters including the remaining processing time.

Cleaning terminates automatically when the specified time has elapsed. A visual indicator notifies the user that plasma cleaning is complete. The specimen remains under vacuum until the user initiates the venting process.

Maintenance

The Model 1070 enclosure has been designed for ease of service.

When connected to the Internet, the Model 1070 can be accessed remotely for diagnostic purposes.

Software tracks the vacuum system's total operating time so that routine maintenance can be scheduled.

Model 1070 NanoClean Accessories

Model 9010 Vacuum Storage Container

Model 9010 Vacuum Storage Container. After cleaning, specimen holders can be inserted into Model 9010 Vacuum Storage Containers so they can be stored or transported under vacuum. A sight glass gives a clear view of the specimen in the specimen holder.

Model 9020 Vacuum Pumping Station

Model 9020 Vacuum Pumping Station. The pumping station simultaneously stores five specimen holders under vacuum. It includes a heavy duty metal base with non-skid feet, five independently valved vacuum storage containers, a vacuum pumping manifold, and all necessary components for connecting to the Model 1070 NanoClean.

Model 1070 specifications

Plasma system	High frequency (13.56MHz) power amplifier inductively coupled to a quartz and stainless steel plasma chamber
	Ion energies of less than 12eV as a function of the downstream plasma
	Automatic matching network
	Compatible with TEM specimen holders for FEI/Philips, Hitachi, JEOL, and Carl Zeiss
Vacuum system	Oil-free turbomolecular drag pump backed by a multistage diaphragm pump
	Vacuum load lock
	Ultimate vacuum of 5×10^{-6} mbar
Chamber	Accepts two specimen holder ports
	Chamber lid provides access for bulk objects up to 3.5" (8.9cm) in diameter
	Viewport for chamber observation
Gas	Three gas inputs
	Nominal 10psi delivery pressure
	Flow rate is controlled by the embedded module
User interface	Programming through a touchscreen embedded module
	Dedicated recipes for EM specimen and grid processing
	Ability to customize parameters
	Process timer for automatic termination
Weight	160 lb (73 kg)
Dimensions	27" (686mm) W x 22" (559mm) H x 22.3" (566mm) D
Power requirements	100/120/220/240VAC, single phase, 660 Watts
Warranty	One year

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E.A. Fischione Instruments, Inc.
9003 Corporate Circle
Export, PA 15632 USA
Tel: 724.325.5444
Fax: 724.325.5443
E-mail: info@fischione.com
Website: www.fischione.com

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