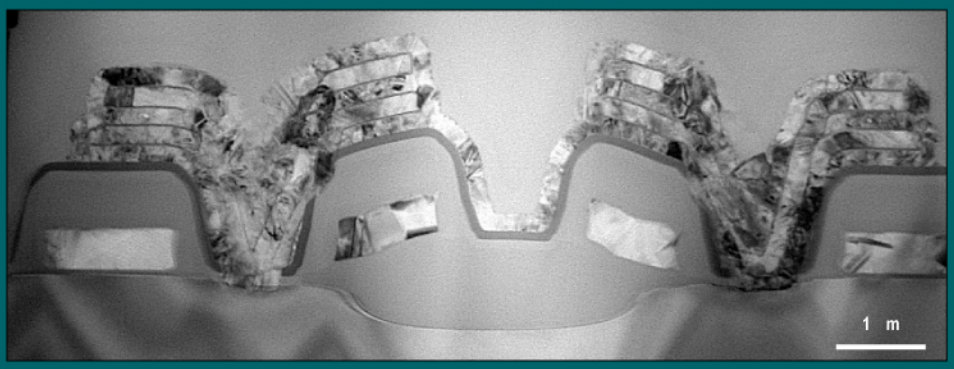
Model 691

Precision Ion Polishing System (PIPS)

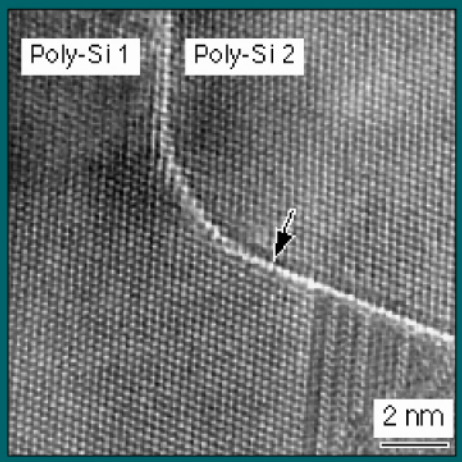
gatan

The PIPS“ is a "user friendly" precision ion polisher designed to produce high quality, TEM specimens with minimal effort.

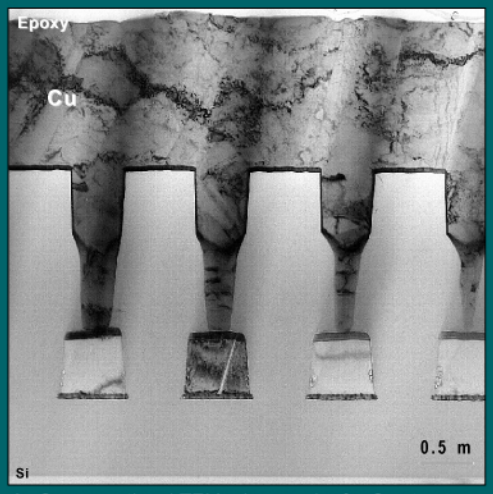


1. Cross-sectional TEM image of an IC device.

2. Cross-sectional TEM view of a very thick (14 m) SiC over layer on a Si substrate.



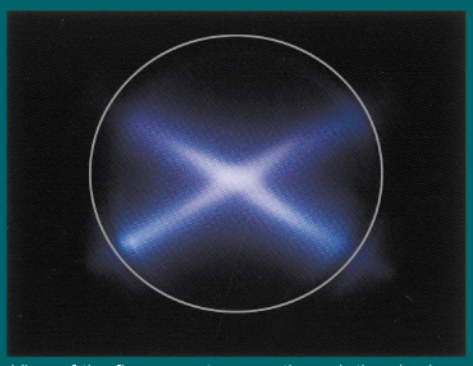
3. HRTEM image of poly Si layers showing cross lattice images with the interface area (arrow).



4. Cross-sectional TEM micrograph of a Cu structure and TaN on an Si substrate.

Emphasizing ease of use, the PIPS features full manual control, making it reliable, simple to operate and easy to maintain. Several unique design features are incorporated into the Gatan PIPS:

- ¥ High milling rates at shallow angles.
- ¥ Penning guns having no consumable parts.
- ¥ Patented Whisperlok“ for fast and simple specimen exchange.
- ¥ Patented specimen holders for double sided, low angle milling.
- ¥ Beam Modulation offering both single and double sector milling.
- ¥ Combined feature set elminates the need for a cold stage.
- ¥ CCD imagery for real-time video monitor imaging. (Optional)
- ¥ Chemically Assisted Ion Beam Etching (CAIBE), greatly improving the thinning of semiconductor materials. (Optional)



View of the fluorescent screen through the viewing window showing the ion beams intersecting at the center.

Penning Ion Guns

The ion guns produce exceptionally fast milling rates at shallow angles. Each ion gun is independently adjustable, using micrometer drives to precisely center the ion beams on the specimen. This alignment becomes particulary critical at angles below 4 degrees and is further facilitated by a fluorescent viewing screen. This screen can also be used to set the optimum gas flow to produce a specific beam diameter. The ion gun design uses a minimum of individual components, and virtually eliminates consumables, such as apertures. Typical gun life in excess of 10,000 hours is routinely obtained.

Whisperlok“ Stage

A patented Whisperlok provides true "Fast Specimen Exchange" (<30 seconds) eliminating the need to vent the main chamber for specimen exchange. Optimized to rapidly and efficiently dissipate heat from the holder, the stage substantially reduces sample heating. Combining this design feature with shallow angle sputtering and Beam Modulation has totally eliminated the need for a "Cold Stage" in the PIPS. Heat sensitive materials such as high T_C superconductor ceramics and InP are easily prepared with no specimen damage.

Beam Modulation

This unique feature offers single or double sector milling with two guns, a distinct advantage over specimen rocking. Beam Modulation compliments the preparation of cross-sections by allowing ion milling of an interface from only one direction (front) or from both directions (front and back). Equally important is Beam Modulations influence on reducing specimen heating. The ion beams are switched ON and OFF sequentially as the sample is rotated, each being OFF during 2/3 of a revolution. This dramatically reduces the heat load on the sample and, in conjunction with the other heat reduction features, eliminates the need for specimen cooling.

Specimen Viewing

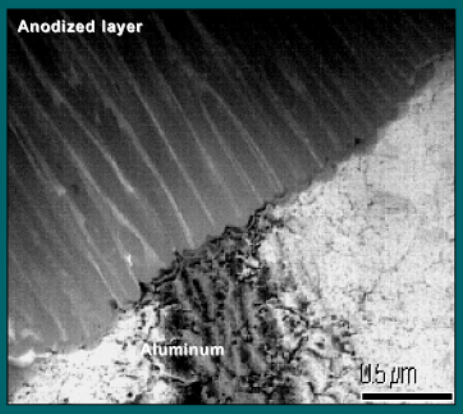
The PIPS is equipped with a low powered binocular microscope. This provides in-situ viewing to inspect the specimen in the airlock or in the working position at any time during the milling process. Transmission and reflection illuminators facilitate specimen viewing. An optional CCD imaging system is also available. *(See information on PIPS Imaging System).*

Vacuum System

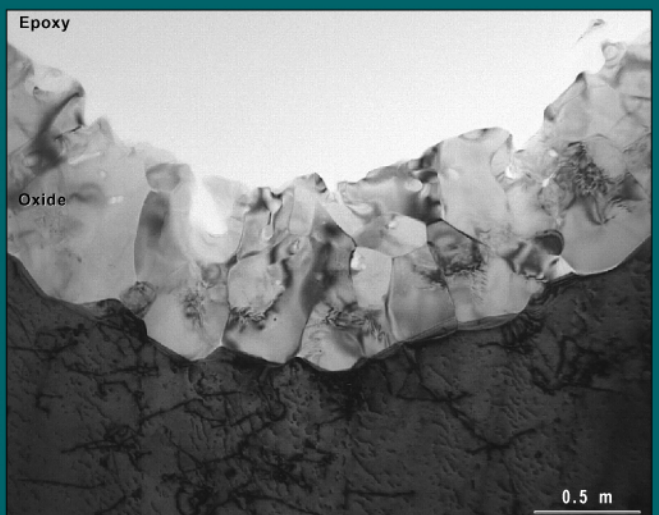
An air-cooled, molecular drag pump, backed by a diaphragm pump, produces a completely oil-free vacuum system. Offering low weight and low heat output, these vacuum pumps are totally contained within the bench top enclosure.

CAIBE (Optional)

The CAIBE system exposes the sample to a reactive gas and an inert gas ion beam. This feature facilitates the production of artifact free TEM specimens of certain compound semiconductors, e.g., InP, with enhanced milling rates.

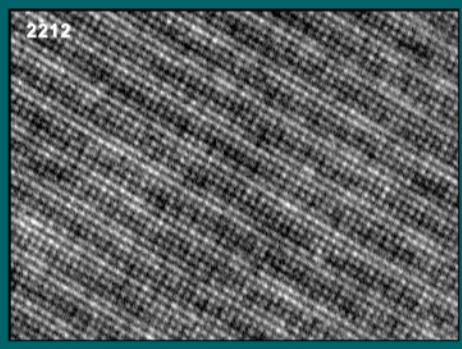


5. *Cross-sectional TEM image showing interface areas of an anodized Al alloy*

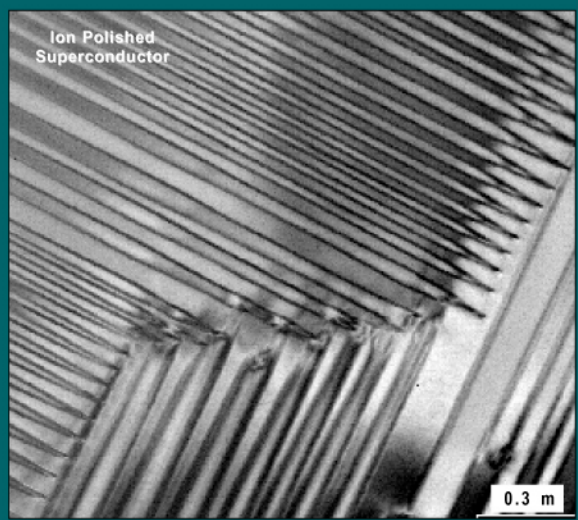


6. *Cross-sectional TEM digital image of an oxidized FeCrAl alloy. It can be seen that along with the metal substrate and G1 epoxy used for cross sectioning, the entire layer of oxide is electron transparent.*

7. *TEM digital micrograph of a two phase material containing Y1Ba2Cu3Oy (YBCO) showing the multiple twinning structure of the superconductor phase (123). Again, the presence of twinning shows that no specimen over-heating has taken place during ion milling in the PIPS.*



8. *High resolution TEM image of T_c superconductor (2212) milled in the PIPS.*



PIPS Imaging System (Optional)

The missing link for improving throughput, consistency and accuracy. Remote Specimen Viewing in Real Time.

Consider the obvious advantages of video monitoring combined with high magnification. Designed to compliment the unique features of the PIPS, the CCD zoom camera offers a more efficient and easy means of monitoring milling progress to the point of perforation. The conventional practice of using low power optical microscopes to view specimen progress has evolved into todays technology of CCD cameras and video monitors. A key factor influencing throughput and precision in ion milling is the current practice of using low power optical microscopes to frequently view the specimen in the milling position or while raised in the airlock. More often however, at various intervals during the procedure, specimens are removed from the ion mill for viewing under a high power optical microscope to observe progress toward a specific site. If additional milling is required, the specimen is returned to the ion mill. This procedure may be repeated numerous times prolonging the overall preparation time and possibly damaging the specimen each time it is handled. The PIPS CCD imaging system totally eliminates these added, potentially costly steps. The system enables you to observe the specimen perforating on the high resolution monitor and to precisely control the perforation size and location. The variable zoom feature offers sharp, clear images and the magnification ability to clearly resolve sub-micron features. Precision of this scale "reduces or virtually eliminates specimen over-milling," increasing throughput and accuracy.

The complete package is configured as a stand alone system making it available for any new PIPS or as an easily installed customer retrofit for any existing PIPS in service. Depending upon ship date, some cabinet modification and additional components may be required to externally mount the diaphragm pump.
Three important factors driving the preparation of TEM specimens today, throughput (cost), accuracy and ease of operation are all realized with this package. Adding speed and performance, this state-of-the-art CCD imaging package extends the value of the PIPS by enhancing and accelerating the ion milling process and TEM specimen production. The system also continues the Gatan tradition of reliability and quality established within the Specimen Preparation product line.

Specifications

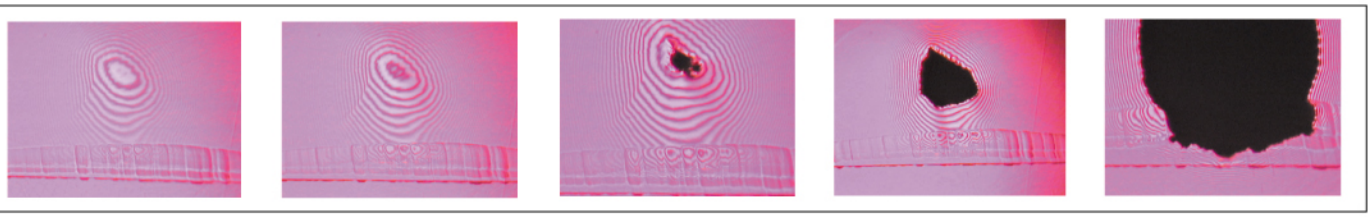
Color CCD Camera

CCD Active Area	3.2mm x 2.4mm (1/4 inch format)
Active Picture Elements	NTSC: 768 (H) x 494 (V), PAL: 752 (H) x 582 (V)
Resolution	NTSC: 470 Horiz TV lines, 350 Vert TV lines PAL: 450 Horiz TV lines, 415 Vertical TV lines
Voltage	12 VDC or 12 VAC

Monitors

Color Monitor 1	SONY Trinatron™ 20"
Magnification	Continuously variable from 400 X - 2600 X
On-Screen Menu	Contrast, Brightness, Color intensity, Color system
Power Requirements	Universal 100 - 240VAC, 50/60Hz
Video Signal	NTSC / PAL, S-Video
Color Monitor 2	15" Flat Panel: TFT-LCD
Magnification	Continuously variable from 200 X - 1900 X
Resolution	1024 x 768
Power Requirements	Universal 100 - 240VAC, 50/60Hz, 35W max.
Video Signal	NTSC / PAL, S-Video

Si single crystal utilizing optical filter for End-Point detection.

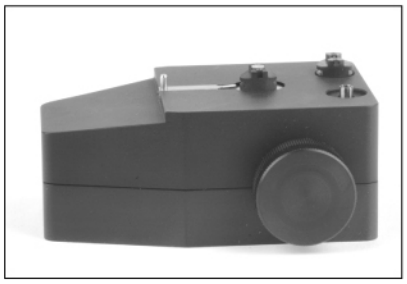


PIPS Specimen Holders

Three unique holders have been developed for the PIPS to service all TEM specimen requirements:

- ***¥ The clamp type DuoPost“ for ease of use and quick specimen exchange.***
- ***¥ The glue type DuoPost“ for brittle and heat sensitive specimens.***
- ***¥ The Graphite holder offering reduced contamination and specimen translation.***

Each holder allows double-sided milling down to angles less than 1 degree. Design of the DuoPost“ and Graphite holder imparts minimal beam exposure and coupled with Beam Modulation significantly extends holder life. Two custom fixtures (Loading Docks) are provided to simplify specimen loading onto these holders.



The Graphite Holder offers the same double-sided low-angle milling (ion polishing) ability as the aluminum DuoPosts“ while providing additional benefits.

Advantages of Graphite

¥ Reduced contamination from the holder
¥ Lower sputtering rate of graphite compared to metals increases life expectancy
¥ Sputtered material is amorphous and conductive which ultimately reduces charging problems associated with insulating materials during TEM examination/analysis

Specimen Secured with Slides

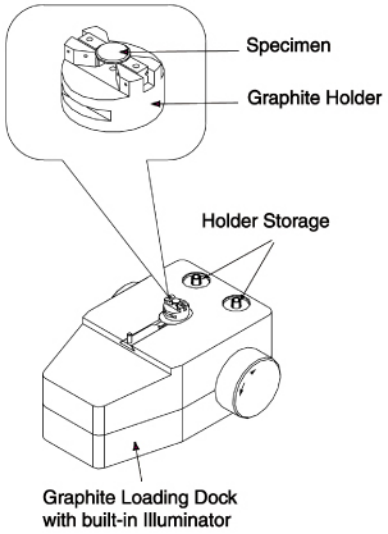
¥ Two independent slides grip the specimen at its outer edge
¥ Specimen can also be secured using a low melting point wax
¥ Slide translation is –0.5mm on either side of center
¥ Slides permit alignment of a specific area on the specimen to the PIPS center of rotation

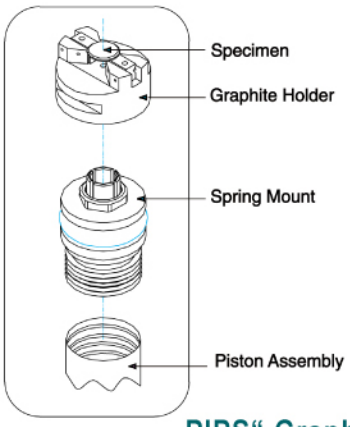
Configured Size

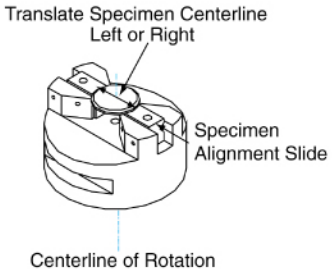
¥ Larger mass relative to DuoPost“ provides more efficient heat dissipation

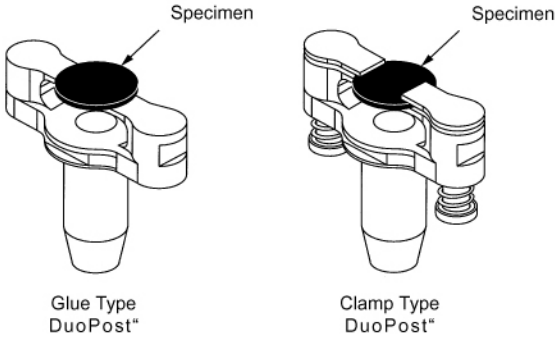
Loading Dock

¥ Simplifies specimen loading onto Graphite Holder
¥ Built-in LED transmission illuminator assists in optical examination of translucent samples (thin Si and ceramics)









PIPS“ Graphite Holder (Optional)

Ordering Information

Model No.	Description
691.08645	Graphite Holder
691.08401*	Spring Specimen Mount Assembly
691.08650	Graphite Loading Dock with LED Illuminator

* Item required only for PIPS shipped prior to 10/98

PIPS“ Aluminum DuoPost“ (Standard)

Ordering Information

Model No.	Description
691.08600.FR	DuoPost, glue type 3mm
691.08601.FR	DuoPost, clamp type 3mm

Specifications

Ion source

Ion Guns	Two Penning ion guns with miniature rare earth magnets
Milling Angle	+ 10¡ to -10¡, Each gun independently adjustable
Ion Beam Energy	1.5keV to 6keV
Beam diameter	350m FWHM at 5keV — 800 m FWHM at 5KeV for Broad Beam guns
Ion Current Density	10mA/cm2 Peak
Beam alignment	Precision beam alignment using fluorescent screen

Specimen Stage

Sample Size	3mm or 2.3mm
Mounting	Gatan patented DuoPost" (Standard) or Graphite Holder (Optional)
Rotation	Variable from 1 to 6rpm
Beam Modulation	Single or double sector for exceptional cross-sectioning
Viewing	Binocular microscope 40X or 80X

Vacuum

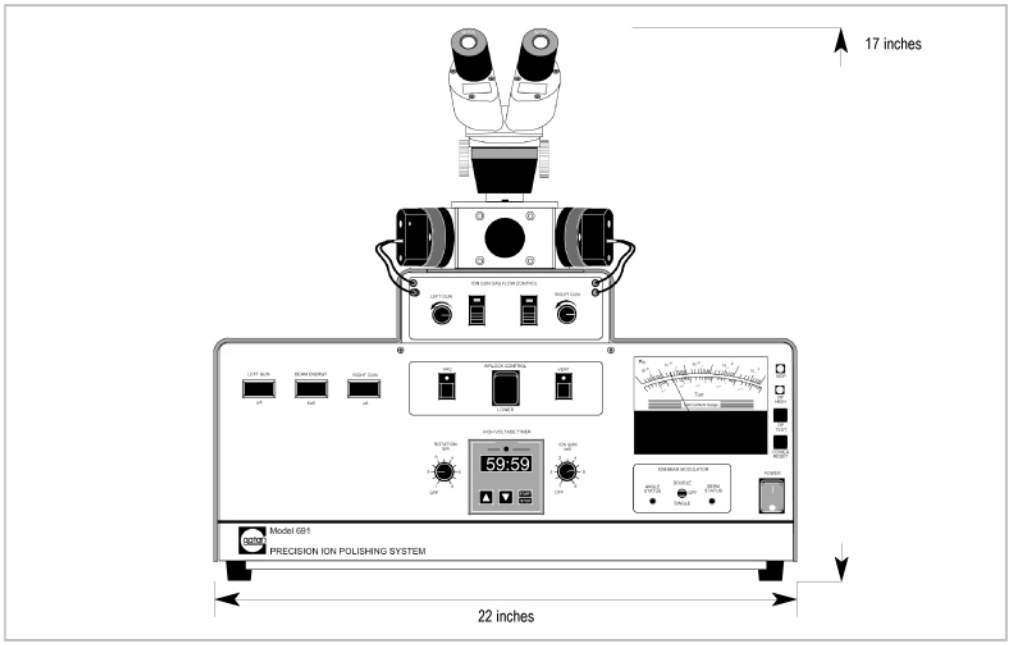
Dry Pumping System	Molecular drag pump backed by a 2-Stage diaphragm pump
Pressure	5E-6Torr base pressure, 8E-5Torr operating pressure
Vacuum gauge	Penning type for main chamber. Solid-state for backing pump
Specimen airlock	Gatan Whisperlok" , specimen exchange time <30 seconds

Dimensions and Utilities

Overall size	560mmW x 480mmD x 430mmH (22"W x 19"D x 17"H)
Shipping weight	45kg (100lbs)
Power Consumption	200 Watts during operation, 100 Watts with guns Off
Power Requirements	Universal 100VAC — 240VAC, 50/60hz *(User to specify voltage and frequency)*
Gas	Argon gas at 25psi (1.42 bar). No water cooling required.

Warranty

2 Years



The Whisperlok" mechanism, the CAIBE attachment and the DuoPosts are protected by US patents 4,272.682, 5,009,743 and 5,472,566.

gatan

www.gatan.com

Gatan Inc.
Corporate Office
Western USA Sales
5933 Coronado Lane
Pleasanton, CA 94588
Tel. (925) 463 0200
Fax. (925) 463 0204
Contact: info@gatan.com

Eastern USA Sales
780 Commonwealth Drive
Warrendale, PA 15086
Tel. (724) 776 5260
Fax. (724) 776 3360
Contact: pmiller@gatan.com

Gatan GmbH
Ingolstdterstr. 12
D-80807 Mnchen
Germany
Tel. +49 89 358084-0
Fax. +49 89 358084-77
Contact: mfels@gatan.com

Gatan UK
Gatan UK, Ferrymills 3
Osney Mead
Oxford, OX2 0ES
United Kingdom
Tel. +44 (0)1865 253630
Fax. +44 (0)1865 253639
Contact: ukinfo@gatan.com

Gatan France
PRINCETON Instruments SARL
3bis, Chemin du Haut Breuil
78113 GRANDCHAMP
FRANCE
Tel: +33 1 34944407
Fax: +33 1 34871668
Contact: dmonville@gatan.com

Nippon Gatan
Hibarigaokaminamikan 6F
3-27-11 Yato-cho, Tanashi-shi
Tokyo 188-0001 Japan
Tel: +81 424 387230
Fax: +81 424 387228
Contact: miyamori@gatan.com

Gatan Singapore
371 Beach Road
#02-03 Keypoint
Singapore 199597
Tel: +65 2933160
Fax:+65 2933307
Contact: frankyfl@singnet.com.sg

Gatan On-line
http://www.gatan.com
info@gatan.com
help@gatan.com