

SMI3200

High Performance Focused Ion Beam System Product Specification Sheet

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1. Product Name

SMI3200 High Performance Focused Ion Beam System

2. Overview

The SMI3200 is an High Performance Focused Ion Beam System composed of a High performance Focused Ion Beam (FIB) optic system and it's controller, a detector, a gas injector, a high vacuum main chamber, a sub chamber, a 200mm wafer compatible sample stage, a vacuum evacuation system, and a computer system. This instrument is able to perform micro cross section processing and observation at any location on a 200 mm wafer with its scanning ion microscope function by ion beam, sputter etching function by ion beam irradiation and deposition function by gas spray and ion beam irradiation.

3. Configuration

3.1. SMI3200 Main Unit

- (1) High performance Focused Ion Beam (FIB) optic system and it's controller
- (2) Detector
Secondary Electron Detector Installed in the High Vacuum Chamber
- (3) Gas Injector Vial-Carbon Gas Injector or Vial-Tungsten Gas Injector
- (4) High Vacuum Main Chamber
- (5) Sub Chamber
Sample Transport System
- (6) 200mm Wafer Compatible Sample Stage
Sample Holder for 200mm wafer or 150mm wafer
- (7) Vacuum Evacuation System
- (8) Computer System

The choice of gas injector must be made before finalizing a contract.
We will verify for our customer-selected contents with the delivery specification sheet.

Please refer to each optional product specification sheet.
We will verify the composition of the instrument by the delivery specification sheet for our customer.

3.2. Standard Accessories

See list for details

3.3. Documentation

- | | |
|--------------------------------|-------|
| (1) Delivery Inspection Report | 1 set |
| (2) Operation Manual | 1 set |

3.4. Delivery, Installation, Adjustments

Delivery, installation, and adjustment will be performed by an engineer designated by SIINT at a location designated by your company. Utility connections will be performed as indicated by your company. Details of this work will be verified with the "SMI3200 High performance Focused Ion Beam System Installation Specification Sheet."

3.5. Operation training

- (1) Operation Training
- (2) Maintenance Training

4. Specifications

4.1. High performance Focused Ion Beam (FIB) Optic System

4.1.1. Performance

(1) Secondary Electron Image Resolution	4nm Beam coincidence and Eucentric point
(2) Maximum Probe Current Density	30 A/cm ² (Calculated Values)
(3) Maximum Probe Current	20nA
(4) Observation Field	0.5 × 0.5μm to 2mm φ (Wide View Mode)
(5) Beam Irradiation Position Stability	0.1μm/10 min
(6) Acceleration Voltage	5 to 30kV Setting in 5kV steps

(1) through (5), acceleration voltage is 30 kV.

SIINT standards are used to verify secondary electron image resolution.

Verification of stability of the beam irradiation position is performed using an SIINT standard sample. At this time a beam irradiation position correction function will be activated.

4.1.2. Ion Source

(1) Ion Source	Ga liquid metal needle ion source
(2) Guaranteed running time	1000h

Operation time is guaranteed only if periodic maintenance was performed on the ion column.

4.1.3. High Performance Focused Ion Beam Optics System

(1) Maximum Acceleration Voltage	30kV
(2) Ion Source Control	Filament Current, Suppression Electrode, Extraction Electrode
(3) Lens	Electrostatic type
(4) Blanking	Electrostatic type
(5) Optical Axis Correction	Electrostatic type
(6) Stigmator Correction	Electrostatic type
(7) Adjustable Aperture	2 Axis Motor Drive
(8) XY Deflector	Electrostatic type Scan Rotation (0~359.9°/0.1° Step Setting)

4.2. Detector

4.2.1. Secondary Electron Detector

(1) Secondary Electron Detector installed in the chamber Scintillator type

4.3. Gas Injector

Specifications common to gas injectors

Nozzle

UP/DOWN type

Gas generation method

Heat Vaporizing method

Source material supply method

Vial Method

Gas source material (an either-or choice)

Gas Material for carbon

Phenanthrene

$C_{14}H_{10}$

Gas Material for tungsten

Hexacarbonyl-Tungsten

$W(CO)_6$

Use the designated gas source material in the gas injector.

Used vial can be disposed of as industrial waste material.

4.4. High Vacuum Main Chamber

Port

Detector port (SED)

Charge Neutralizer port

Gas Injector port (2)

Light port

4.5. Sub Chamber

Sample Transport System

Motor Drive

4.6. 200 mm Size Compatible Sample Stage

4.6.1. Sample Stage

Eucentric Tilt	
5 Axis Motor Operation	XY feed-back control
Stage Repeatability	1.0um (1σ)(X, Y)
Operation Range	X = 0 to 205mm Y = 0 to 205mm Z = 0 to 21.5mm θ = 0 to 360° endless Rotation T = -4 to 60° Tilt

The method of confirming stage reproducibility is listed in the delivery inspection report.

4.6.2. Sample Holder

Sample Shape	200mm or 150mm JEIDA standard wafers The sample holder is compatible with both orientation-flat and notch types by interchanging with standard parts.
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When using samples other than JEIDA standard wafers, the other type sample holders need to be purchased separately.

4.7. Vacuum Evacuation System

(1) Control method	Automatic control
(2) Vacuum pump	
High vacuum main chamber	Turbo-molecular pump 450 L/s equivalency
Sub chamber	Turbo-molecular pump 50 L/s equivalency
Ion Source Chamber	Noble Ion Pump 30 L/s equivalency
Roughing Vacuum Pump	Rotary Pump 250L/min equivalency
(3) Vacuum Level Monitor	
High Vacuum Main chamber	Combination Gauge (Penning Gauge + Pirani Gauge)
Sub chamber	Pirani gauge
Ion source chamber	Nobel Ion Pump Discharge Current Pirani gauge
(4) Attainable Vacuum Degree	
High Vacuum Main chamber	8×10^{-5} Pa or less
Ion Source Chamber	1×10^{-5} Pa or less

Vacuum is measured by the vacuum measure function that comes with this instrument.

4.8. Computer System

4.8.1. Operation Computer

CPU	DOS / V Compatible, Pentium® 4	(2.4GHz) or more
Memory	512MB or more	
Hard Disk	80GB or more	
Memory medium	CD-R/RW, FDD	
OS	Windows® XP	
Network	10BaseT / 100BaseT	
Display	17" Liquid Crystal Collar Display, 1280x1024dots	
Operation Unit	English Keyboard, Mouse	

4.8.2. Hardware Control Computer

CPU	MC68030	25MHz
Memory	4MB or more	
Hard Disk	1GB or more	
OS	OS-9 ®	
Operation Unit	Operation Panel	
	MAG	Changes size of field of view
	FOCUS	
	STIGMA X, Y	Astigmatic Correction
	BRIGHTNESS	
	CONTRAST	

4.8.3. Operation

Entry	Operator Mode / Staff Mode Operator Registration Login Record
Ion Source	Start Heating
Sample Transfer	Load/Unload
Ion Beam Current Adjustment	Beam current setting
Ion Beam Scan	Scanning Speed Change Dot Accumulation Frame Accumulation Field of View Size Change Scan Rotation
Sample Position Adjustment	Sample Height Adjustment Support (Eucentric calculation) Centering Sample Stage Movement Observation/Process Position Memory
Observation	Save of Observation Images Print of Observation Images
Standard Process	Sputter Etching Deposition Slope Cut
Application Process	Cross-Sectioning & Observation TEM Sample Preparation Program Process
Process Support	Auto correction of ion beam irradiation position (One Point Drift Correction)

5. Utilities

5.1. Electricity

Voltage	Single phase AC200, 208, 220, 230, 240V±10%
Current	20A
Consumed Power	1.7kVA in normal use
Frequency	50/60Hz
Ground	D type ground 100 ohms or less

5.2. Nitrogen Gas

Purpose	Drives valves and vents vacuum chamber
Purity	99.95%
Supply	24 hours continuous
Pressure	0.5 to 0.7MPa (5 to 7kg/cm ²)
Usage flow	30 L/min when replacing samples
Connections	6 mm or 1/4" Swagelok® Couple

5.3. Evacuation Ducts

Purpose	Evacuation of roughing vacuum pump
Connections	NW25 Quick Coupling
Evacuation amount	250 L/min or more

5.4. Network

Standard	10BaseT / 100BaseT
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Operations related to network connection are to be carried out by the customer.

6. Installation Room

6.1. Installation Environment

(1) Room Temperature

Set value	22±3°C
Tolerance variation value	Set value: ±1°C
Tolerance variation rate	0.5°C/hr or less

(2) Humidity

Tolerance level	35 to 60%
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(3) External magnetic field variation

	Tolerance level
DC component	0.1μT/5min or less (1mG/ 5 min or less)
AC component	0.5μT or less (5mG or less)
	Periodically the external magnetic field must be less than the geomagnetic level about 30μT (0.3G).

Steep variation of the magnetic field will result in noise in the image even within the permitted value.

(4) Floor Vibration

	Horizontal direction	
	Frequency	Tolerance level
	1 to 5 Hz	amplitude 1.0 μm p-p or less
	10 to 50 Hz	amplitude 0.5 μm p-p or less
	50 to 300 Hz	acceleration $5 \times 10^{-2} \text{m/s}^2$ (5gal) or less
	Vertical direction	
	Frequency	Tolerance level
	1 to 5Hz	amplitude 1.0 μm p-p or less
	5 to 80 Hz	amplitude 0.2 μm p-p or less
	80 to 300 Hz	acceleration $5 \times 10^{-2} \text{m/s}^2$ (5gal) or less

Because correct measurements of floor vibrations of 1Hz or less are difficult, there are times when the effects of the environment measurement, performed previously, cannot be predicted.

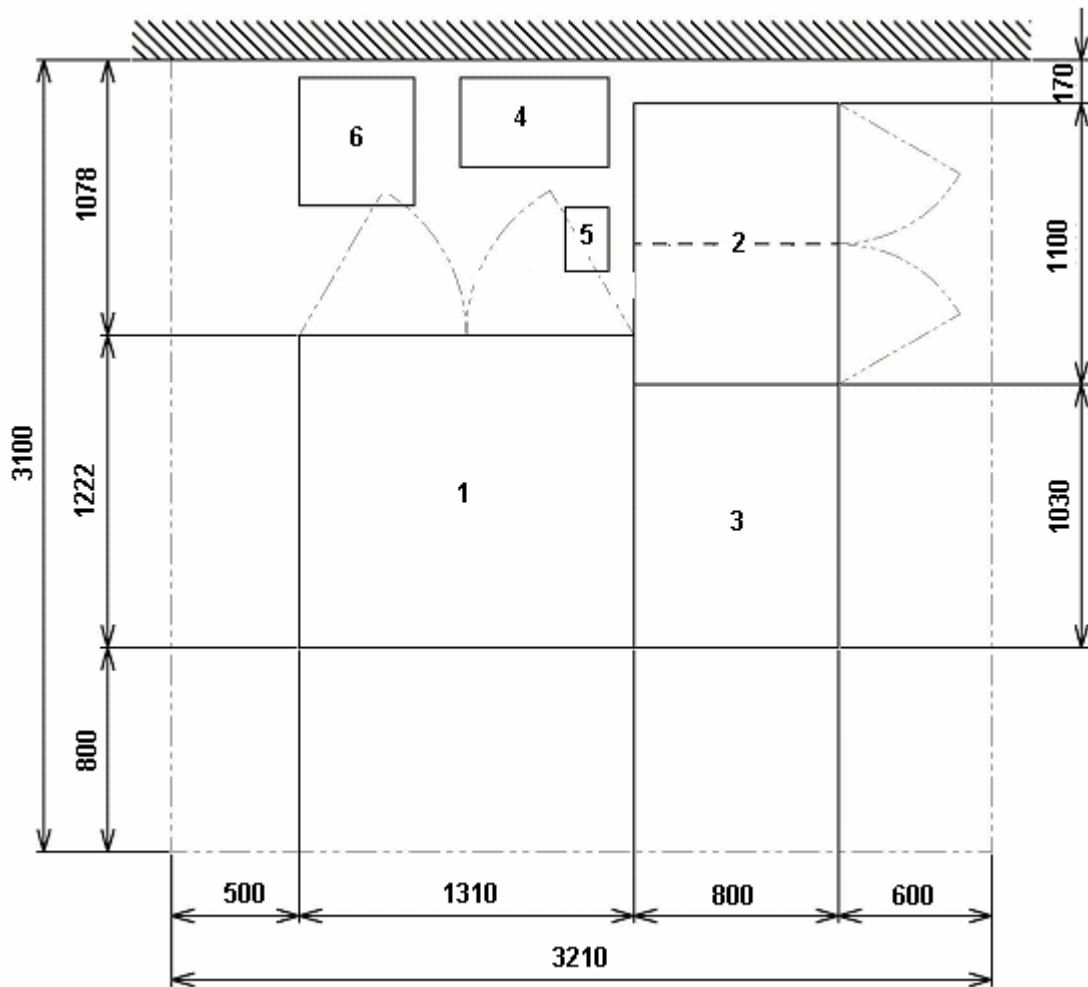
(5) Noise(Sound Level)

Tolerance level	65 dB (A mode) or less
	70 dB (C or F mode) or less
	There must not be specific frequency peak

(6) Floor load

Tolerance level	4000N/m ² or more (400 kg/m ² or more)
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6.2. Installation Example



Units: mm

- 1: Main unit
- 2: FIB Controller Cabinet
- 3: Operation Table
- 4: Rotary Pump
- 5: Vibration Reducer Weight
- 6: Transformer Box

Please verify details of the installation using the Installation Specification Sheet.
Additional options (MGS, etc.) will change the layout.

7. Acceptance

SIINT will install and adjust the product and train your company in how to handle the instrument. Acceptance is when the instrument successfully passes the inspection as based on the Installation Inspection Report.

8. Intellectual Property Rights

SII NanoTechnology Inc. cannot be held responsible for damage caused by products in which this instrument was involved in making by a purchaser who infringed on intellectual property rights in possession of a third party.

Sale of this instrument does not mean the granting of intellectual property rights possessed by SII NanoTechnology Inc. SII NanoTechnology Inc. permits only the use of intellectual property rights in the use of this instrument.

9. Warranty

Defects that occur within one year of the date of acceptance will be repaired free of charge. However, repairs will not be free of charge in the following cases.

- (1) Malfunctions caused by mistakes in operation.
- (2) Malfunctions caused by modifications to the instrument without the consent of SIINT.

Do not install any software on the operation computer. Only the software installed by SIINT at the time of delivery should be on the operation computer.

- (3) Malfunctions resulting from natural disasters or calamities or incidents
- (4) Malfunctions caused by changes in the installation environment

If the instrument is transferred without the consent of SII NanoTechnology Inc., SII NanoTechnology Inc. will determine that there was a change in the installation environment.

There will be a charge during the warranty period for consumable parts and their replacement or any recovery operation if the instrument has not been in use for a long period of time or in consequence of a power outage, as well as costs required for periodic maintenance.

Details about warranty and maintenance conditions are decided based on Maintenance Specifications and related documentation.

10. Consumable Parts

Item	Product Name	Replace	Remarks
Ion Source	LMIS2 Ion source	1000h	Only an SIINT maintenance person can perform replacement.
FIB aperture assembly	FIB aperture assembly (K-W11100518)	1000h * 1	Adjustable aperture part. Only an SIINT maintenance person can perform replacement.
Vial carbon gas injector material	Vial carbon gas injector material	300h Deposition	PhenanthreneC ₁₄ H ₁₀ Replenish amount: 0.3 g Only an SIINT maintenance person can perform replacement. * 2
Vial tungsten gas injector material	Vial tungsten gas injector material	80h Deposition	Hexacarbonyl-tungsten W(CO) ₆ Replenish amount: 2.5 g Only an SIINT maintenance person can perform replacement. * 2

* 1 : Time is based on the operating time.

* 2 : Replacement is able to be done by a staff who has been trained in handling without any system performance warranty.

Our guarantee concerning the ion source:

Defective parts occurring within the warranty period will be replaced free of charge.

However, the following cases are not free of charge regardless of operation time.

- (1) If the condenser lens aperture and block has not be properly maintained by periodic maintenance.
- (2) If the ion source is replaced by someone who has not been trained in handling.
- (3) If the integrated usage time of the ion source used in the free-of-charge replacement is already more than 1000 hours. Nevertheless, when the operation time of a defective ion source under proper usage conditions does not meet 50 hours, it will not be added to the integrated usage time.
- (4) Usage begins after the one-year storage period after delivery.

11. Periodic Maintenance

Periodic maintenance is required to maintain the performance as listed in this Product Specification Sheet. All maintenance is performed by an engineer from SIINT.

Maintenance Items	Frequency	Remarks
Secondary electron detector	2000h*	Scintillator
Condenser lens aperture	2000h*	
Condenser lens block	The shorter one of 4000h* or one year	
Blanking electrode	The shorter one of 4000h* or one year	
Rotary pump	once/year	
TMP for sample transfer system	once/year	
Gas injector maintenance	once/year	
Chamber vacuum gauge maintenance	once/year	
FIB column isolation valve O-ring	once/year	

*Time based on ion source operating time.

12. Standard Accessories

Item	Quantity	Remarks
Ion Source	1	Delivered with it installed in the instrument
Gas material selected	1	Material compatible with the gas injector comes with the gas injector at the time of delivery.
Precision Driver	1 set	
Ball Point Hexagonal Wrench	1 set	
O-rings	1 set	
Aluminum Alloy Stand	1	Used when replacing the ion source.
Sample Height Confirmation Tool	1	
Operation Manual	1 set	Included with the unit
Container	1	Use for storing standard accessory tools

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