29 June, 2011

PRELIMINARY SPECIFICATION

Customer : National Nano Device Laboratories

Model : Multi Chamber Sputtering System

Type : ENTRON W200 1E2T2L 200mm dia.wafer

Quotation No. : QE10-1188

ULVAC Engineering Dept.		
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ULVAC, Inc.

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1.GENERAL DESCRIPTION

1.1 PURPOSE

The Entron W-200 is a single-substrate sputtering system compatible with mass-production processes that allows maximum efficiency for the selection in a number of small-scale, high-efficiency production line(s), as well as maximizes the semiconductor manufacturer′s capital investment.

1.2 FEATURES OF SYSTEM

1) System Configuration

Equipped with minimized equipment and functions, this system can be expanded according to process requirements and consists of the following units.

A : Standard unit (SU) : Standard
B : Configurable unit (CU) : Must always be selected to configure a system
C : Optional unit (OU) : Need not always be selected to configure a system.

(1) System configuration

* Single-substrate sputtering system equipped with a buffer station as standard. (Loading port: maximum four stations)
* Space saving core (for both 200/300mm substrates)
  The core type can be selected according to the number of modules required by process.
  Single core (CU) : The pentagonal core unit can accept a maximum of two single-substrate load/unload chambers (one chamber is optional) and three process chambers.
  Tandem core (CU) : A square core (RX) can be joined to the back of the pentagonal core (FX) via an intermediate chamber (MS). Maximum two load/unload chambers (one chamber is optional) and two process chambers can be installed on FX, and three process chambers can be installed on RX.
* Single-substrate load/unload chamber
  In addition to pumping and venting functions, multiple functions that conduct heating and cooling in the same chamber can be selected. Also a cold trap can be selected according to application.

(2) Compatible with ultrahigh vacuum (SU)

Each chamber has an independent pumping system. Also a sequence can be selected, whereby only one isolation valve can be opened/closed during transfer. Cross contamination between chambers can be prevented and clean ultrahigh vacuum in each chamber can be maintained. Clean ultimate pressure can be attained and low background can be obtained by employment of a magnetic bearing type turbo molecular pump, a cold trap (-150°C) and a dry pump for each module and transfer chamber.

- Transfer chamber / process chamber : Turbo molecular pump (magnetic bearing type) plus cold trap (compressed helium type)
- LA/LB chamber : Turbo molecular pump (magnetic bearing type)
- Roughing / TMP backing : Dry pump

2) Ultra-High Vacuum Transfer Robot

The wafer transfer vacuum robot is KEYTRAN IV (with Z shaft, double arm) employing an ultrahigh vacuum-compatible stepping motor. The radius of gyration is held to a minimum for space saving of the core unit

3) Sputtering chamber

The sputtering chamber employs the sputter-down system using a permanent magnet rotating magnetron cathode, and the chamber interior is simple in structure, resulting in ease of maintenance. Cathodes recommended by ULVAC (Normal, LTS, MCS, SIS, etc.) can be installed according to the process specifications.

The substrate heating mechanism is a hot plate type with an electrostatic chuck (low/high temperature type) that excels in heat transfer. Also a cooling stage can be selected according to the purpose of process specifications. In a chamber in which both metal film deposition and nitride film deposition are coprocessed like Ti/TiN process, a vacuum motor drive shutter mechanism is installed as standard.

4) Etching chamber (Damage free)

The etching chamber permits high-rate, damage-free pretreatment by employment of the ICP type RF etching mechanism. ULVAC hot plate with electrostatic chuck can also be selected according to the purpose of the process specifications.

5) Degas chamber

The preheating chamber can be configured for a lamp heating mechanism or a hot plate substrate heating mechanism with electrostatic chuck for degas before processing. Also the pumping system and isolation valve are optional.

6) Control software

The control software for this system uses ULVAC′s CyberCELL, which is a common control software platform for ULVAC semiconductor fabrication equipment. Operation is performed only on a Cluster Tool Controller (CTC) that has operator—friendly-human-interface designed under SEMATECH guide line. And the design of CyberCELL meets also the next generation of 300mm Fab. FA and CIM interface capabilities.

2. SYSTEM LAYOUT

2.1 SYSTEM FOOTPRINT

This system was designed for a Class 1 Clean room environment. Maintenance from the front side is only load ports because of the EFEM. Therefore, maintenance from the rear side gray area is required for all core and main process units.

The approximate machine size, excluding EFEM, are as follows :

(S: Single core, T: Tandem core)

∗ Main system: 2675mm（W）× S: 2140mm（D）× 3800mm（H）

T: 3898mm（D）

∗ Main system ＋ Buffer Station (except load port) + Maintenance Area:

4353mm（W）× S: 3415mm（D）× 3800mm（H）

T: 5586mm（D）

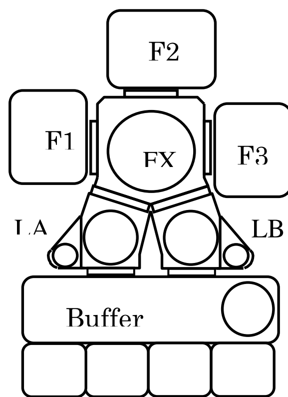
* Pump/Power Supply Rack: 4870mm（W）× 5500mm（D）× 2200mm（H）

2.2 System Components

This system consists of four main sections:

- Core section : 2 Load/Unload chamber, Transfer chamber (FX, RX), Control system, etc.
- Process Module : Sputter, Etch, Degas
- Pump/Power Supply Rack : Dry pump, Sputter/Etch Power Supplies, Compressors, etc.
- Computer Section : Main computer, PC rack

<Single Core > **<Tandem Core >**



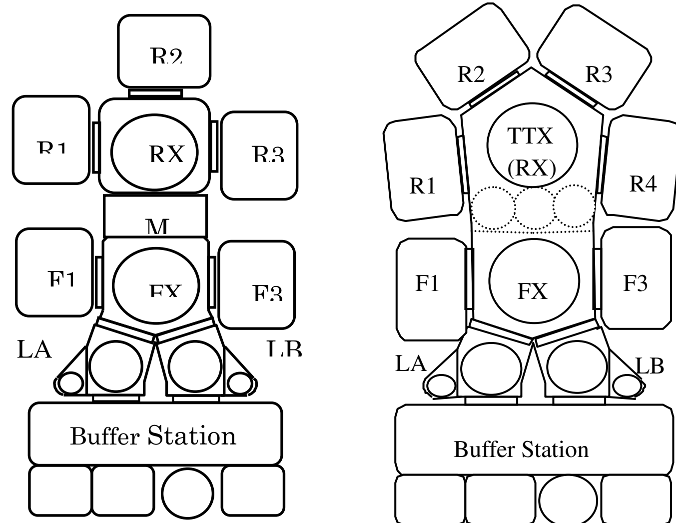


Fig.1 Configuration

3. SYSTEM CONFIGURATION

3.1 Specification summary on this system

1) Process summary : Cu seed layer

(See Section “DESCRIPTION OF COMPONENTS” for details)

2) Wafer size : 200mm-diameter (SEMI M1.9)

Diameter:200mm +/-0.2mm, Thickness:725 +/-20micro-m, Notch depth:1.0 +0.25/0.0mm

All chamber, cathode, and stage correspond to 200mm-diameter wafer.

3) Core section : Tandem core (ULVAC parts No. NCH-6200T-1CP)

4) Front-End : EFEM: RORZE (Parts No. 31RS8151-001) (SEMI E63) with 3 Load ports

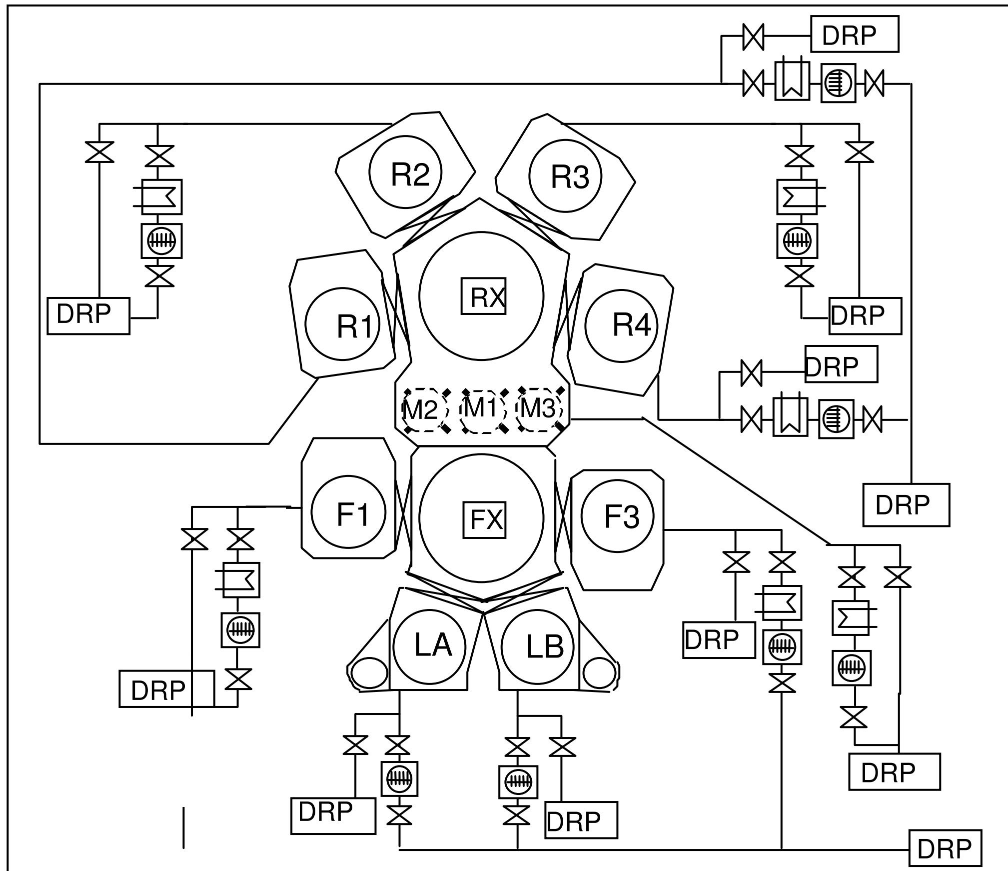
Load port: SMIF200

5) Load/Unload : Batch type, 2 chambers (LA, LB), Degas/Cool functions are installed.

6) Common specification : ULVAC standard safety specification based on S2-93

7) Process chamber : Hydrogen Reactive ICP Etch x 1, SIS Ta x 1, SIS Cu x 1

3.2 VACUUM AND MODULE CONFIGURATION



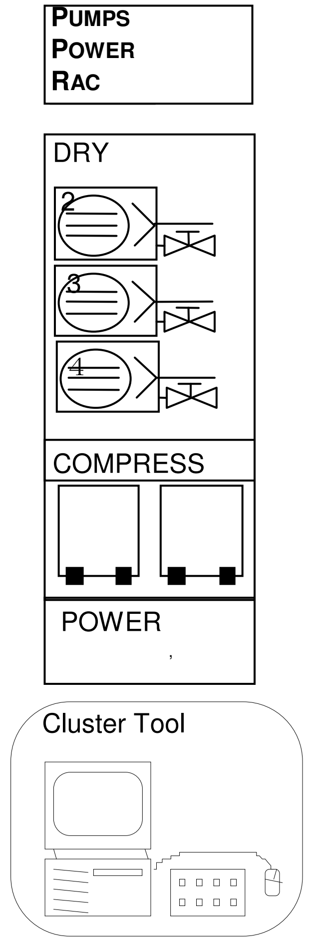


TABLE 1, PUMPING SYSTEM OF EACH CHAMBER

No.	Module	Check	ISO.V	Pump System	Vender
LA	Load/Unload	Yes	Yes	TMP-403LM	Shimazu
LB	Load/Unload	Yes	Yes	TMP-403LM	Shimazu
FX	Transfer Chamber	Yes	---	TMP-403LM CRYO-T6X-RS5	Shimazu ULVAC-CRYO
F1	Etching Chamber	Yes	Yes	TMP-1003LM CRYO-T8SN-RS10	Shimazu ULVAC-CRYO
F3	Blank	---	---	---	---
RX	Transfer Chamber	Yes	---	TMP-403LM CRYO-T6X-RS5	Shimazu ULVAC-CRYO
R1	Sputter Chamber (SIS Ta)	Yes	Yes	TMP-1003LM CRYO-T8SN-RS10	Shimazu ULVAC-CRYO
R2	Sputter Chamber (SIS Cu)	Yes	Yes	TMP-1003LM CRYO-T8SN-RS10	Shimazu ULVAC-CRYO
R3	Blank	---	---	---	---
R4	Blank	---	---	---	---
	Common			DRP1:(for roughing, Core&F*&R*) DRP2/3:(for TMP fore, Core&F*&R*) DRP4:(for H_2 process , ICP module) Cryo compressor : C30ZR	ULVAC ULVAC ULVAC ULVAC-CRYO

Process Module Configuration

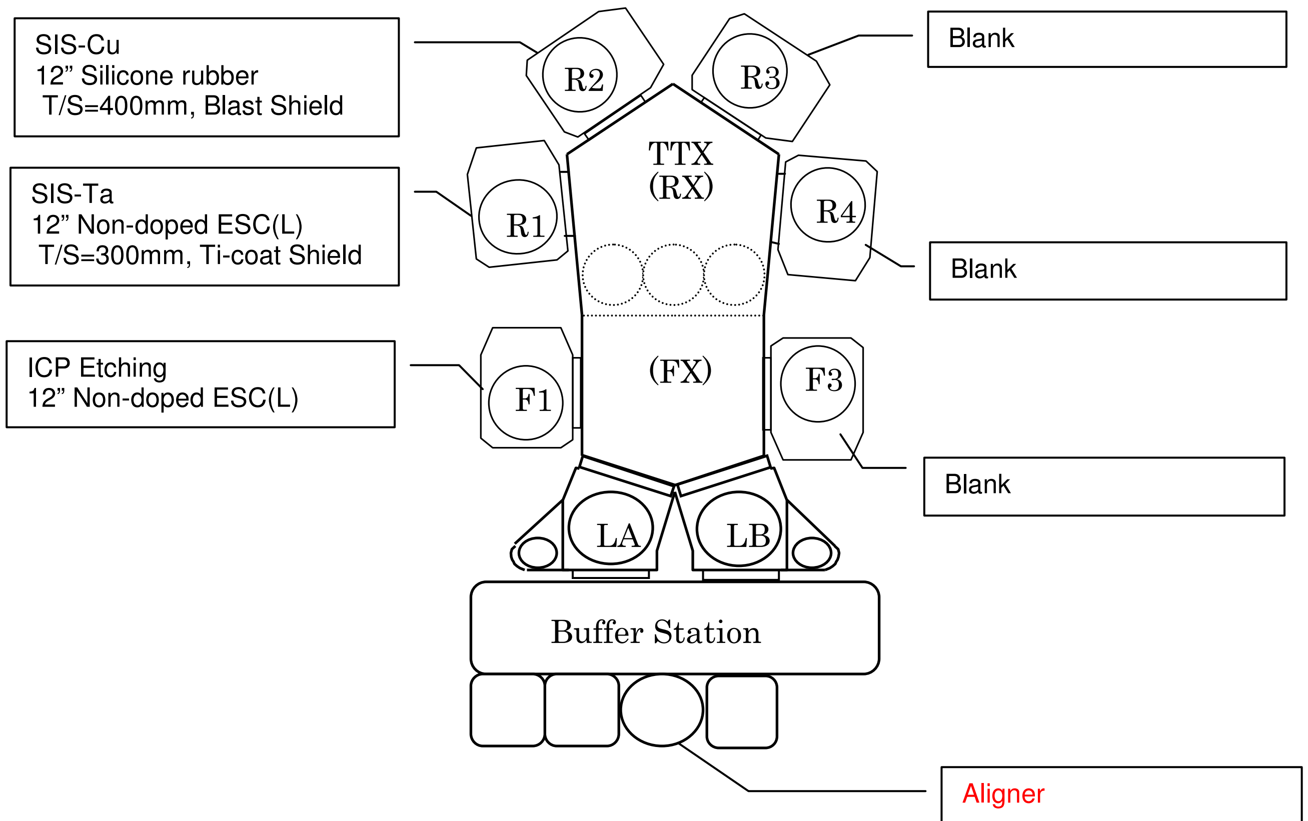


Table 2. System Configuration

No.	Module	Mat.	T/S	Components
LA	Load/Unload	---	---	Pump/Vent/Degas/Cool Multi-Function,RGA Port
LB	Load/Unload	---	---	Pump/Vent/Degas/Cool Multi-Function,RGA Port
FX	Transfer Chamber	---	---	8 site Core, Keytran-Ⅳ(Z axis),Dual arm
F1	Etching Chamber (H2 Reactive ICP)	---	---	Gas:2 Line(Ar, H2), Parallel Antenna mechanism,Shield:Alumina Parts,12” Non doped ESC(L),RF P.S.:RFS1305A/RFS1205A,
F3	Blank	---	---	
FX	Transfer Chamber	---	---	5 site Core, Keytran-Ⅳ(Z axis),Dual arm
R1	Sputter Chamber (SIS Ta)	Ta	300	Gas:2 Line(Ar, N2), 12” Non doped ESC(L) , Magnet rotation, Shield : Ti treatment,DCPS:Pinacle(Maste/Slave/IR PS), RF P.S.:TX10-000-00, MD Shutter mechanism
R2	Sputter Chamber (SIS Cu)	Cu	400	Gas：1 Line(Ar), 12”Si rubber plate, Magnet rotation Shield : Blast, DC P.S.:HPK15Zi(Master/Slave),ESS200, RF P.S.:TX10-000-00
R3	Blank	---	---	
R4	Blank	---	---	

3.3 LAYOUT

The installation location is subject to the following restrictions because of the specifications of components and must be selected carefully. It is requested that the customer contact ULVAC before ordering if there is any question about installation.

* Electrical wiring (signal and power line) : 23 m

* Wiring for turbo molecular pump : 23 m

* He flexible hose for cryo cold trap : 23 m

* Vacuum piping from main system to pump rack : 23 m or less

It is to be noted that the values above represent the total length of wiring/piping and not the rectilinear distance.

3.4 SOFTWARE SPECIFICATION

1) Control system : CyberCELL (by ULVAC)

Master-Slave control between modules

Targeted to be based on 300mm SEMI standard

2) Host communication : SECS/GEM based on SEMI standard

(not included in the quotation of this specification)

3.5 CUSTOMER SUPPLIED PARTS

1) Sputtering target : Ta x1, Cu x1

2) SMIF for load-port on EFEM(Wafer carrier) x3

4. PERFORMANCE

4.1 VACUUM PERFORMANCE

The performance given here is the warranted performance when the chamber is clean in the initial state and is under specific conditions. These values will differ from the values obtainable during routine operation.

1) Load lock chamber (LA/LB)

Ultimate Pressure : 6.0E-5 Pa or less

Pressure Rise : 8.0E-7 Pa･m3/s or less

Pump Down Time : Less than 30 sec, to 8.0E-3 Pa

Vent Time : Less than 30 sec, to reach ATM

2) Transfer Chamber (FX/RX)

Ultimate Pressure : 8.0E-5 Pa or less

Pressure Rise : 8.0E-7 Pa･m3/s or less

3) Etching chamber (R2/3･ICP)

Ultimate Pressure : 6.0E-6 Pa or less

Pressure Rise : 8.0E-7 Pa･m3/s or less

Pump Down Time : Within 4 hrs.to8.0E-5 Pa

4) Sputtering Chamber

Ultimate Pressure : 5.0E-6 Pa or less

Pressure Rise : 8.0E-7 Pa･m3/s or less

Pump Down Time : Within 2.5 hrs. to 8.0E-5 Pa

[Conditions for Verifying Vacuum Performance]

A. Each chamber shall be continuously pumped for more than 12 hours after baking, and then the ultimate pressure shall be verified.

B. The vacuum chamber shall be at ambient temperature.

C. There shall be no wafers in the vacuum chamber.

D. The chamber shall be vented with dry nitrogen gas, and pumping of load-lock chamber shall be started after released atmosphere for 5 minutes, and pumping of process chambers shall be started after released atmosphere for 30 minutes.

E. Clean Room temperature shall be at 22 ºC and humidity shall be 45% or less.

4.2 SPUTTERING PERFORMANCE

4-2-1. Sputtering Rate.

SIS Ta	:	45 nm/min or more
SIS TaN	:	45 nm/min or more
SIS Cu	:	400 nm/min or more

4-2-2. Thickness Uniformity

1) Within a wafer

SIS Ta	:	5.0%@ or better
SIS TaN	:	5.0%@ or better
SIS Cu	:	5.0%@ or better
2) Wafer to Wafer	:	3.0%@ or better

4-2-3. Sheet Resistance Uniformity

1) Within a wafer

SIS Ta	:	5.0%@ or better
SIS TaN	:	5.0%@ or better
SIS Cu	:	5.0%@ or better
2) Wafer to Wafer	:	5.0%@ or better

[Ancillary condition for verifying sputtering performance]

A. The substrate shall be 200mm dia. wafer of thermal SiO2 on pure bare Si.

B. Film thickness shall be measured by surface profile measuring system (*ex.Sloan DEKTAK*), or Laser measuring system (*ex. Impulse, Metapulse*)

C. Film thickness and sheet resistance for performance check shall be

Ta : 100nm, Cu : 100nm

D. Sputtering conditions shall be set by ULVAC.

E. Sputtering rate is the average value of the film thickness on a wafer divided by the sputtering time. The calculation method for the average value is as follows:

Average $$Xa = \left(\sum_{i=1}^{n} Xi \right) / n$$ n : total number of measuring point

F. Film thickness uniformity within a wafer shall be measured at programmed 9 points (Edge exclusion is 5mm). The measuring points is shown in Figure 2 as follows:

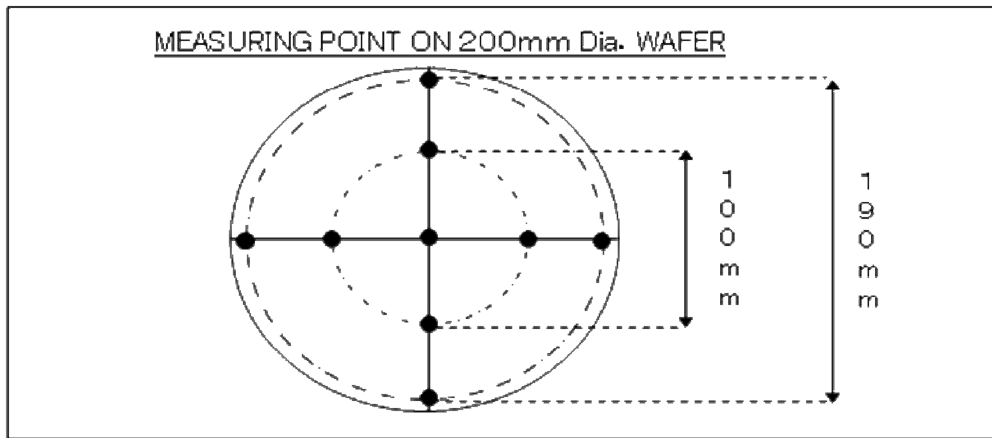


Figure 2: Measuring Points for deposition Uniformity

G. Film thickness uniformity shall be calculated by below.

$$\sigma = \sqrt{\left\{ \sum_{i=1}^{n} (Xi - Xa)^2 \right\} / (n-1)}$$

Xi : value of the measured point

n : total number of measuring point

$$\text{Uniformity} = \sigma / Xa$$

H. The formula for calculating film thickness uniformity within a wafer is same as G.

I. Film thickness uniformity wafer to wafer shall be measured at the center point of the 1st, 5th, 10th, 15th, 20th and 25th wafers (total of 6 wafers) out of a 25 wafer lot. The calculation method is the same as above (H).

4.3 ETCHING PERFORMANCE (AR PVD ETCH)

4.3.1 Etching rate : 30.0nm/min

4.3.2 Etching uniformity

Within wafer : 5.0%

Wafer to wafer : 3.0%

[Ancillary Conditions for Verifying Etching Performance]

A. 200mm-dia. Silicon wafer with specular surface or oxide film will be used.

B. Nanospec or equivalent surface profiler should be used to measure film thickness.

C. The film thickness of the sample to be used for film thickness measurement is 100nm or more.

D. Etching conditions are used for ULVAC POR recipe of Ar etching.

E. The etching rate is the average value of etching divided by etching time.

F. The calculation method of the average value shall be same as sputtering rate

G. The measuring points on the wafer are as same points as sputter performance.

H.The calculation method of Etching uniformity shall be same as Sputtering deposition uniformity.

4.4 SUBSTRATE HEATING PERFORMANCE (HOT PLATE WITH ESC)

4.4.1 Temperature uniformity within a wafer : Δ20 degree C. at set temperature 200 degree C

4.4.2 Term of normal operation : From 100 to 300 degree C.

[Conditions for Verifying Heating Performance]

A. The substrate shall be 200mm-diameter of 100nm thick thermal oxide on silicon wafer.

B. Temperature shall be measured by bonding CA thermocouple (type K) on the wafer.

C. Temperature uniformity shall be measured when the substrate temperature is in equilibrium in the neighborhood of 200 degree C.

D. The temperature uniformity shall be measured at the 9 points shown in Figure.4.

E. Temperature uniformity within a wafer shall be calculated by (Maximum temperature – Minimum Temperature) using 9 points data on the wafer.

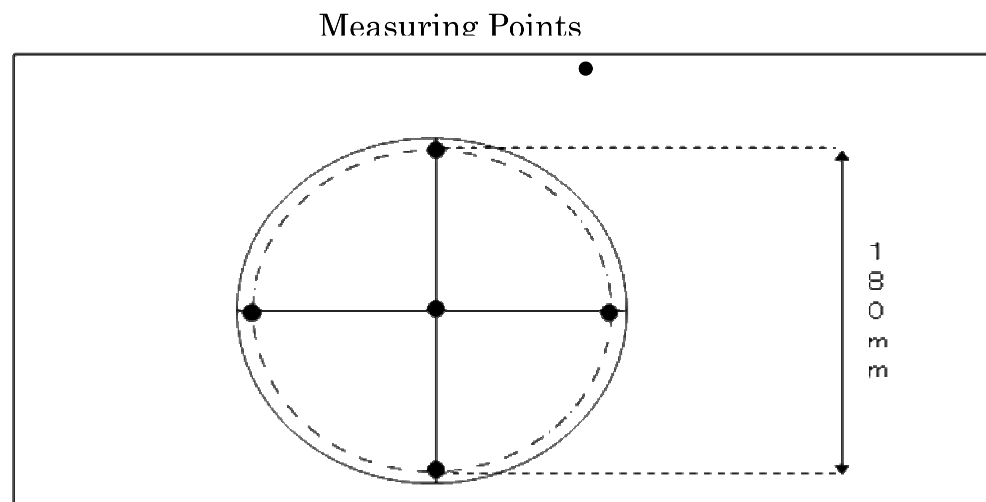


Figure 4. Measuring point for heating performance

4.5 SUBSTRATE HEATING PERFORMANCE (IR LAMP HEATER AT LOAD LOCK CHAMBER)

4.5.1 Temperature uniformity within a wafer : ±20 degree C. at set temperature 250 degree C

4.5.2 Term of normal operation : From 150 to 350 degree C.

[Conditions for Verifying Heating Performance]

A. The substrate shall be 200mm-diameter of 100nm thick thermal oxide on silicon wafer.

B. Temperature shall be measured by bonding CA thermocouple (type K) on the wafer.

C. Temperature uniformity shall be measured when the substrate temperature reaches a stable point (after 50 seconds of heating start).

D. The temperature uniformity shall be measured at the 9 points shown in Figure.4.

E. Temperature uniformity within a wafer shall be calculated by (Maximum temperature – Minimum Temperature) using 9 points data on the wafer.

4.6 TRANSFER PARTICLE (COLD RUN IN VACUUM)

The number of particles 0.2 micro-meter or large on a wafer surface shall be

MAX 40 pcs./wafer or less.

[Condition for Verifying Transfer Particle]

A. The substrate shall be 200mm-diameter bare silicon wafer. The number of initial particles 0.16 micro-meter or large on a wafer surface shall be 20 pcs./wafer or less shall be used.

B. This performance shall be measured approximately 1 hour or more (for stabilization) after cleaning the inside of chamber.

C. 5mm edge exclusion for measurement is required.

D. Samples shall be measured of 1st, 5th, 10th, 15th, 20th, and 25th wafers (total 6 pcs.) out of 25 pcs. of wafers. Transfer for sampling shall be 2 lots, one is from LA and one is from LB.

E. Wafers shall be transferred from a load-lock chamber back to the same load-lock chamber through all process chambers.

F. Wafer holding time in each process chamber shall be 15 seconds without sputtering, etching, and gas flow.

4.7 PARTICLE IN FILM (HOT RUN)

The number of particles 0.2 micro-meter or large on a wafer surface shall be

SIS Ta 25 nm: maximum 40 pcs./wafer (5mm edge exclusion)

The number of particles 0.2 micro-meter or large on a wafer surface shall be

SIS TaN 25 nm: maximum 40 pcs./wafer (5mm edge exclusion)

The number of particles 0.3 micro-meter or large on a wafer surface shall be

SIS Cu 100 nm : maximum 40 pcs./wafer (5mm edge exclusion)

The number of particles 0.2 micro-meter or large on a wafer surface shall be

Etch net 20 nm: maximum 40 pcs./wafer (5mm edge exclusion)

4.8 TRANSFER RELIABILITY

Transfer 1,000 pieces of wafer without failure

[Conditions for Verifying Transfer Reliability]

A. No trouble, no alarm, no wafer-breakage, and no wafer-chipping shall be required.

B. Heating process without ESC shall be acceptable. The heating condition shall be set by ULVAC.

C. Accumulation without continuous lots shall be available.

D. Continuous lots for 2 hours with no failure shall be required at FAT instead of 1,000 pcs. of transfer.

4.9 RELIABILITY

MTBF 400hr or more

MTTR 4hr or less

[Conditions for Verifying Reliability]

A. Calculation period

It will be calculated according to the following content based on the reliability evaluation guideline. The total calculation is assumed to be the one calculated for the 3 months consecutive measurement period after the installation completion.Pass or fail is judged with the total calculation for three months.
The warranty period is assumed to be 9months (12 months from the calculation starting) from point that the total calculation passed.

B. The following items is assumed to be caluculated as a trouble

a. Failure of composition equipment (component and manufactured parts)
b. Trouble in equipmet design, production, and adjustment
c. Software ploblem
d. Trouble during processing

However, the PM about shield kit must be executed at an appropriate cycle. The shields kit and targets will be assumed to use the agreed item by both NDL/ULVAC.Each standard value is assumed the one by the standard agreed value by both parties separately and assumed not to fall below the standard value described in this specifications.

C. The following items to be the excluded when total calculating although it will assume the record.

a. Customer’s trouble shooting(include oncall trouble shooting.Only ULVAC onsite troble shooting will count.)
b. Trouble that occurs by originating primary side utility.
c. Trouble that originates in improper handling and maintenance.
d. Trouble that occurs along with defect and that of supplied goods (target, wafer, cassette, and shield kits, etc.)
e. Trouble that occurs along with trouble that occurs due to a natural disaster.
f. Trouble admitted not to originate in the system.

D. About the failure rate

The failure time contains the following time.

e. Time from the trouble report (service call) to delivery as a rule.
f. Time required from service call to person in charge arrival (transfer time)
g. The required time to obtain the replacement parts.
h. The confirmation working time by ULVAC service engineer.
i. The repair time contains the repairing time by the correspondence of the operator of your company.

E. MTBFand MTTR calculation

MTBF=2,160/ (total frequency of the trouble that occurred in consecutive 3months): (time)
However, in case that the trouble frequency is 0(zero), it counts 2,160 hours.
MTTR = (between the total time to the equipment recovery)/(total frequency of the trouble): (time)
*MTTR is assumed the reference value, and will be calculated totally and be recorded.

F. Reliabilty data calculation

After 3months total calculation based on above mentioned formula, the reliability data report will be submitted by NDL/ULVAC conference. After the exclusion of item (3) paragraph is confirmed, it is assumed the excluded one when ending for the reliability calculation period. Moreover, the improvement of tool activity can be executed continuously after tool move-in and the improvement of tool uptime will be executed.

G. This Item exclude from the acceptance criteria.

4.10 ACCEPTANCE TEST ITEM LIST

The following list shows the detail of the acceptance test items for both internal inspection and installation of system. If the necessity for increasing or reducing test items is required, both customer and ULVAC should discuss to agree upon the terms. The result must be recorded in meeting minutes.

No.	Acceptance Test Item	Internal Factory Inspection	Installation on Customer's site
1	***Vacuum Performance***	3/3 Items	2/3 Items
	1) Ultimate Pressure	YES	YES
	2) Pressure rise value	YES	YES
	3) Pump down recovery time	YES	NO
2	***Sputtering Performance***	2/2 Items	6/6 Items
	1) Sputtering Rate	YES	YES
	2) Film Thickness Uniformity	YES	YES
3	***Etching Performance***	2/2 Items	2/2 Items
	1) Etching Rate	YES	YES
	2) Etching Uniformity	YES	YES
4	***Substrate Heating Performance (Hot Plate)***	5/5 Items	5/5 Items
	4.1 HOT-PLATE Heater	2/2 Items	2/2 Items
	1) Temperature uniformity within a wafer	YES	YES
	2) Maximum temperature confirmation	YES	YES
	4.2 IR Lamp Heater	2/2 Items	3/3 Items
	1) Temperature uniformity within a wafer	YES	YES
	2) Maximum temperature confirmation	YES	YES
5	***Transfer Particle Performance***	0/1 Item	1/1 Item
	1) Transfer Particle	NO	YES
	Particle In Film	0/2 Items	2/2 Items
6	1) Sputtering Particle	NO	YES
	2) Etching Particle	NO	YES
	Transfer Reliability	1/1 Item	1/1 Item

	1) Reliability	YES	YES
	TOTAL	12 Items	14 Items

5. DESCRIPTION OF COMPONENTS

5.1 TARGET DIMENSIONS

1) Ta : 312mm dia. x 12mm thickness. Diffusion bonding type.

2) Cu : 312mm dia. x 12mm thickness. Indium bonding type.

* Drawing of target will be provided from ULVAC to customer.

5.2 COMPONENTS LAYOUT

This system consists of four main sections:

1) Core section : 1 EFEM, 2 load-lock chambers, 1 Transfer chamber, and Control system

2) Process module : 1 Etching, 2 sputtering

3) Pump/Power supply rack : Dry pump, TMP controller, Sputter power supply, and else.

4) Computer section : Main computer, CRT, and PC rack

Around the front side 5 angle transfer chamber is arranged Load-lock chamber at LA and LB, Etching chamber at F1.

Although around the back side 5 angle transfer chamber is arranged Sputtering chamber at R1, R2.

Shown in the Figure 5 about module number.

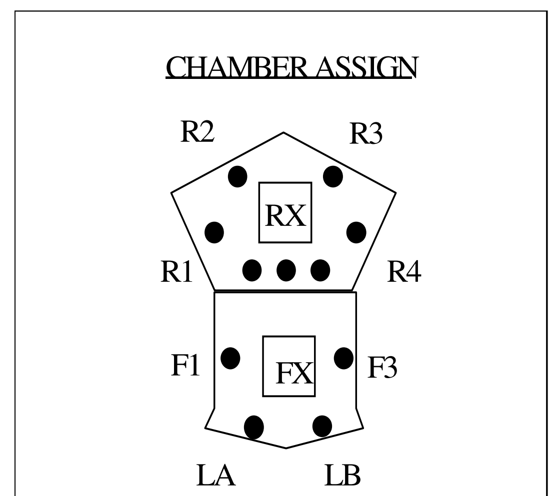


Figure 5 : Chamber Assign

5.3 DESCRIPTION OF COMPONENTS

5.3.1 Equipment-Front-End-Module (EFEM): 31RS8151-001 <Rorze> .... 1 set

5.3.2 CORE SECTION

Tandem core: NCH-6200T-1CP

1) 8 angle Transfer chamber (FX) .... 1 set

2) Extra Pentagonal core (TTX (RX)) .... 1 set

2) Slit valve (Core section) : NKV2-12U <Irie> .... 2 sets

3) Ultra-high vacuum transfer robot : Keytran-ⅣZ <ULVAC> .... 1 set

5) Single wafer load lock type load-lock chamber: LA, LB .... 2 sets

6) Substrate heating mechanism: LA, LB .... 2 sets

7) Substrate cooling stage : LA, LB .... 2 sets

8) Turbo molecular pump for LL ,FX,RX: TMP-403LM <Shimazu> .... 4 sets

9) Dry mechanical pump (Total 4 sets)... 4 sets

10) Cold trap for FX/RX : CRYO-T6X RS-5 <ULVAC CRYO> .... 2 sets

11) Helium compressor : C30ZR (6 channel multi) .... 2 sets

12) Chamber baking mechanism .... 1 set

13) Ion gauge : G-TRAN box unit hot cathode gauge BMR2 <ULVAC> .... 4 sets

14) Sensor of Ion gauge : Miniature metal Gauge M-13 <ULVAC>.......................... 4 sets

15) Low vacuum gauge : G-TRAN box unit pirani gauge BPR2 <ULVAC>................ 4 sets

16) Sensor of low vacuum gauge : pirani gauge WPB-10-034 <ULVAC>.................. 4 sets

17) Control system : CRT, CTC, TMC, UC .... 1 set

*CTC equips mirror ring disc unit as software backup

5.3.3 ICP ETCHING CHAMBER F1

(1) Module summary

1) Chamber main body (aluminum alloy) with baking heater 1set

2) Vacuum inverter : ZSE6B-A2AA2-67L <SMC>.. 1 set

3) Main pump/turbo molecular pump: TMP-1003LM<SHIMADZU> .... 1 set

4) Cold trap: CRYO-T8SN-RS10 <ULVAC CRYO>... 1 set

5) Helium compressor: C30ZR (6 units) <ULVAC CRYO> (common with each chamber)

6) Roughing pump/dry pump (common with each chamber)

7) TMP fore pump/dry pump (individual)

8) Main valve: type 8 poppet valve.. 1 set

9) Isolation valve: NKV2-12U<Irie Koken>.. 1 set

10) TMP fore valve: XLC40 <SMC>... 1 set

11) Roughing valve: XLC25 <SMC> .... 1 set

(2) Elevating mechanism

1) Wafer elevating mechanism.. 1 set

2) Etching shield elevating mechanism... 2 sets

(3) Etching shield

1) One-action cylindrical shield type deposition shield (surface subjected to blast treatment, made of Al2O3) .... 1 set

(4) Wafer Heating system

1) Wafer stage with heating mechanism .... 1 set

2) Platen ring (made of SUS304) .... 1 set

3) Hot plate type heater with electrostatic chuck (KH2901N low temperature type) 1 set

4) Temperature controller : SR-25 <Shimaden> .... 1 set

5) CA thermocouple .... 2 sets

(5)LT ICP unit

1) Antenna mechanism.. 1set

2) Substrate electrode mechanism... 1set

3) Ground shield 1set

(6) ICP maintenance mechanism.. 1set

(7) Chamber venting unit

1) Diaphragm valve: FPr-SD-71-6.35-2 <Fujikin> 1pc

2) Filter: NAS-clean N30 <Nippon Seisen> 1pc

(8) Process gas supply system

1) Argon gas line

- Diaphragm valve : FPR-SD-71-6.35-UP <Fujikin>... 1 pc
- Mass flow controller: SEC-F730 (digital control) GAS1:Ar = 100 sccm <STEC> ... 1 pc
- Auto regulator: UR-7340M0-UC <STEC> .... 1 pc

- Stop valve: FPR-SD-71-6.35-2-UP <Fujikin> .... 1 pc
- Filter: NAS-clean M1 <Nippon Seisen> .... 1 pc
- Joints (VCR joint and others/ultra-clean type) <Fujikin> .... 1 set

2) Hydrogen gas line

- Diaphragm valve: FPR-SD-71-6.35-UP <Fujikin> .... 1 pc
- Mass flow controller: SEC-F730 (digital control), H2 =200sccm <STEC> ..... 1 pc
- Auto regulator: UR-7340M0-UC <STEC> .... 1 pc
- Stop valve: FPR-SD-71-6.35-2-UP <Fujikin> .... 1 pc
- Joints (VCR joint and others/ultra-clean type) <Fujikin> .... 1 set

(9) Vacuum measuring instrumentation

1) Ion gauge: G-TRAN box unit hot cathode ion gauge BMR2<ULVAC> .... 1 set
2) Sensor of Ion gauge: Metal gauge M-13 <ULVAC> .... 1 set
3) Pirani gauge: G-TRAN box unit Pirani gauge MPR2<ULVAC> .... 1 set
4) Sensor of Pirani gauge: Pirani gauge WPB-10-034<ULVAC> .... 1 set

(10) Etching power supply

1) RF power supply and controller for Antenna: RFS1205A <ULVAC> .... 1 set
2) RF power supply and controller for Bias: RFS1305A<ULVAC> .... 1 set

(11) Heating Power Supply for Hot-plate : thyristor/Transformer

1) Thyristor unit/transformer (dual type) 1set

5.3.4 SPUTTERING CHAMBER (2 chambers) R1/R2

R1: T/S300 SIS –Ta

R2: T/S400 SIS –Cu

(1) Module summary (2 modules as R1/R2)

1) Chamber (alminum:A5052) with bake-heater .... 2 sets

2) Vacuum inverter: ZSE6B-A2AA2-67L <SMC> .... 2 sets

3) Main pump/Turbo molecular pump : TMP-1003LM <SHIMADZU> .... 2 sets

4) Cold trap : CRYO-T8SN RS10 <ULVAC CRYO> .... 2 sets

5) Main valve : 8" poppet valve <ULVAC> .... 2 sets

6) TMP fore valve : XLC40 <SMC> .... 2 pcs

7) Roughing valve : XLC25 <SMC> .... 2 pcs

8) Slit valve : NKV2-12U <IRIE> .... 2 sets

9) Helium compressor: C30ZR (6 units) <ULVAC CRYO>(common with each chamber)

10) Roughing pump/dry pump (common with each chamber)

11) TMP fore pump/dry pump (common with each chamber)

12) Isolation valve: NKV2-12U<Irie Koken> .... 2 sets

(2) Wafer lifter mechanism

1) Wafer lifter mechanism .... 2 sets

2) Deposition shield lifter mechanism .... 4 sets

(3) Deposition shield

1) Cylindrical easy install type shield (SUS304) .... 2 sets

(4) Wafer Heating /cooling system

1) Cooling system with wafer stage .... 2 sets

2) Platen ring (SUS304) .... 2 pcs

3) Silicone rubber with electrostatic chuck (Silicone -300-NT) <ULVAC> .... 1 pc

4) Hot plate type heater with electrostatic chuck (KH2901N low temperature type) . 1 pc

5) Temperature controller : SR-25 <SHIMADEN> .... 2 sets

6) CA thermocouple sensor (type K) .... 4 sets

7) Cooling water pump unit(Chiller) for Cu(R2)stage < RISSY> .... 1 set

(5) Sputtering Cathode unit (for R1/2)

1) SIS cathode (T/S = 300,400) .... 2 sets

2) Ground shield (SUS304) .... 2 pcs.

(6) Cathode maintenance mechanism .... 2 sets

(7) Chamber venting unit

1) Diaphragm valve : FPr-SD-71-6.35-2 <Fujikin> .... 2 pcs.

2) Filter : NAS-clean N10 <Nihon-seisen> .... 2 pcs.

(8) Process gas feed system

1) Argon gas line

- Diaphragm valve : FPr-SD-71-6.35-2-UP <Fujikin> .... 2 pcs.
- Mass flow controller : SEC-F730(digital control), 100sccm <STEC> .... 2 sets
- Automatic pressure regulator : UR-7340MO-UC <STEC> .... 2 set
- Stop valve : FPR-SD-71-6.35-2-UP <Fujikin> .... 2 pcs
- Filter : NAS-clean M1 < Nihon-seisen > .... 2 pcs
- Joint : VCR/ultra-clean type < Fujikin > .... 2 sets

2) Nitrogen gas line (for R1)

- Diaphragm valve : FPr-SD-71-6.35-2-UP <Fujikin> .... 1 pc.
- Mass flow controller : SEC-F730 (digital control), 100sccm <STEC> .... 1 set
- Automatic pressure regulator : UR-7340MO-UC <STEC> .... 1 set
- Stop valve : FPR-71-6.35-2-UP <Fujikin> .... 1 pc.
- Filter : NAS-clean M1 < Nihon-seisen > .... 1 pc.
- Joint : VCR/ultra-clean type < Fujikin > .... 1 set

(9) Vacuum measuring system

1) Ion gauge : G-TRAN box unit hot cathode gauge BMR2 <ULVAC> .... 2 sets

2) Sensor of Ion gauge : M13 metal gauge<ULVAC> .... 2 pcs

3) Low vacuum gauge : G-TRAN box unit pirani gauge MPR2 <ULVAC> .... 2 pcs

4) Pirani vacuum gauge : WPB-10-034 <ULVAC> .... 2 sets

(10) Sputtering Power Supply

1) DC power supply for Cathode: HPK-15Zi (Master/Slave)<Kyosan>for Cu .... 1 set

2) DC power supply for Ion Reflector: ESS200-50-2-D <Lambda EMI> for Cu ...... 1 set

3) DC power supply for Cathode: Pinacle (Master)<AE> for TaN/Ta .... 1 set

4) DC power supply for Ion Reflector: Pinacle (Slave)<AE> for TaN/Ta .... 1 set

5) RF power supply for Bias:TX20-D000-00<ADTEC> 2000W/13.56MHz for Cu .. 1 set

6) RF power supply for Bias:TX10-D000-00<ADTEC> 1000W/13.56MHz for TaN/Ta 1 set

(11) Heating Power Supply for Hot-plate : thyristor/Transformer

1) Thyristor unit/transformer (dual type) .... 1 set

(12) Shutter Mechanism

1) Vacuum motor drive shutter mechanism 1set

5.3.5 MISCELLANEOUS

1) Framework, etc.

① Main frame, Front panel, Maintenance stage.. 1 set

2) Pump/Power supply rack

① Rack for 2 sets of Dry pumps, TMP controller, Sputtering/Etching power supply,

Wafer heating power supply, He compressor, etc. .... 1 set

3) Piping

① Vacuum line piping (Stainless steel) .... 1 set

② Compressed He line for cryo cold trap (Copper : inside the main system,

Flexible tubing : Main system to Pump rack)) .... 1 set

4) Compressed air line

① Solenoid valve, Tube, Joint, Speed controller, etc. .... 1 set

5) Cooling water line

① Cathode line (Solenoid valve, Check valve, Flow switch, Pressure switch,

Auto coupling, Pipe, Joint, etc.) .... 1 set

② Main system (Solenoid valve, Check valve, Flow switch, Flow meter, Auto coupling,

Pipe, Joint, etc.) .... 1 set

③ Pump/Power supply rack (Stop valve, Check valve, Flow meter, Auto coupling,

Pipe, Joint, etc.) .... 1 set

6) Control systems

① Human interface : CTC(cluster tool controller) DMCC-14-P2-300 <COMPAQ> 1 set

② Platform controller : TMC(transport Module controller) ME1 <ULVAC> .... 1 set

③ Process module controller : PMC(process module controller) ME1＜ULVAC＞ 1 set

④ Utility controller : UC(Utility controller) ME1 <ULVAC> .... 1 set

7) Maintenance tool (Target exchange handle and desk, etc.) .... 1 set

8) Cooling water pump unit(Chiller) for cathode .... 1 set

5.3.6 SPARE PARTS (included in this specification and quotation)

Following shows spare parts included in this specification and quotation, shall be delivered with this Entron system.

1) Maintenance parts for sputtering modules (Ta)

- Ion refractor(SUS304 Ti-treatment) .... 1 pc
- Upper Deposition Shield① (SUS304 Ti-treatment) .... 1 pc
- Upper Deposition Shield② (SUS304 Ti-treatment) .... 1 pc
- Lower Deposition Shield (SUS304 Ti-treatment) .... 1 pc
- Platen Ring (SUS304 Ti-treatment) .... 1 pc
- 12” dummy wafer .... 1 pc

2) Maintenance parts for sputtering modules (Cu)

- Ion refractor(SUS304) .... 1 pc
- Upper Deposition Shield① (SUS304) .... 1 pc
- Upper Deposition Shield② (SUS304) .... 1 pc
- Cover ring (SUS304) .... 1 pc
- Platen Ring (SUS304) .... 1 pc

3) Maintenance parts for Etching modules

- E chamber Shield Ceramic Ring .... 1 pc
- Shield Ceramic Ring .... 1 pc
- Electrode Quartz Ring .... 1 pc
- Plasma Adjustment tool for Center Plate .... 1 pc
- Plasma Adjustment tool mounting Plate .... 1 pc

4) Maintenance parts for wafer heating system of sputtering module

- Silicon rubber plate .... 1 pcs
- ESC hot-plate （Non-doped low temp. type） .... 1 pc
- Cu plate .... 1 pc

- Feed Through system parts for electric current .... 4 sets
- Hot plate screw.. 2 sets

5.3.7 Miscellaneous

1) Auto loader finger .... 1 set
2) KeytranIV Pickup .... 2 sets
3) Consumable Parts (O-ring set) .... 1 set
4) Sensor head(M-13,WPB-10-034) .... 2 sets
5) Maintenace tool 1set

5.3.8 OPTIONAL ITEMS (included as follows)

1) Substrate heating mechanism in load-lock chamber.. 2 sets
2) Substrate cooling stage in load-lock chamber.. 2 sets
3) MD Shutter Mechanism with Dummy wafer.. 1 set
4) Equipment-Front-End-Module .... 1 set

6. UTILITY SPECIFICATION (ESTIMATE VALUES)

Following is estimate values for utility. Accurate values shall be provided in

equipment drawings. Required drawings will be provided separate from this specification.

1) Electric power

● Main-1 : 200VAC +/- 10% or less, 3 Phase, 50/60Hz, can be maintained circuit to 25% down and

100msec. or more of power interruption

Load power 400A/130kW

● Main-2 : 200VAC +/- 10% or less, 3 Phase, 50/60Hz, can be maintained circuit to 25% down and

100msec. or more of power interruption

Load power 450A/150kW

2) Water supply

● Chamber

Supply : From 0.5 to 1.0 MPa, from 20 to 25 deg.C, 35L/min. or more, Rc1

Return : backing pressure 0.05MPa, Rc1

Water quality : 10k-ohm*cm (100micro-siemens) or more

● Pump rack

Supply : from 0.2 to 1.0 MPa, from 20 to 25 deg.C, 29L/min. or more, Rc1 1/4

Return : backing pressure 0.05MPa, Rc1 1/4

Water quality : 10k-ohm*cm (100micro-siemens) or more

● Cathode water

Supply : from 0.5 to 1.0 MPa, from 20 to 25 deg.C, 50L/min. or more, Rc1 1/2

Return : backing pressure 0.05MPa, Rc1 1/2

Water quality : 10k-ohm*cm (100micro-siemens) or more

● Cathode drain

Drain out line

3) Compressed air supply

● IN : more than 0.5 MPa, Rc3/8

● OUT : connected an evacuation duct hose of dry pumps

4) Process gases supply

● Argon in : from 0.1 to 0.3MPa, 1/4 VCR

● Nitrogen in : from 0.1 to 0.3MPa, 1/4 VCR

● Hydrogen in : from 0.1 to 0.3MPa, 1/4 VCR

5) Vent gas supply for chamber (Nitrogen)

● System in : more than 0.7 MPa, 1/4 VCR

● Dry pump in more than 0.7 MPa, 1/4 sweage

6) Evacuation duct hose : NW40 x3

7) Vacuum : from -67 to –93kPa (for EFEM)

8) Earth line

A class (1st class) Earth line (10ohm or less)

This system shall be connected class 1 earth line as duty in JAPAN because of high voltage. Therefore, this earth line shall be recommended for overseas customers to provide safety.

7. CONTROL SPECIFICATION

1) Supply voltage : 200VAC +/- 10% or less, 3 Phase, 50/60Hz, can be maintained circuit to 25% down and 100msec. or more of power interruption.

2) Operation circuit voltage : design specification 24VDC or less (5VDC, 12VDC, 15VDC, 24VDC)

3) ULVAC responsibility for manufacturing : inside of system as secondary zone

4) Power supply for computers : UPS' (Uninterrupted power supply) as standard equipment are installed for backing up computers

5) Electric leak breaker : installed for main circuit of system (Sensitivity=100mA)

If customer provides another breaker for the primary line (customer's zone), please install one which has 100mA or more of sensitivity.

6) Annual maintenance

ULVAC recommends for any customer to order the inspection of floppy discs and hard disc using for CTC computer one time / year (will be charged), and to order the exchange of them one time / 2 years (will be charged).

7) Attached documentation for control system

● overview drawings for operation system

● main circuit diagrams

● List of electric parts

Drawing of units and power supply systems will be attached in manuals.

8) Ability against noise

● Power supply lines

Normal mode noise : +/- 1500V (1 micro-second)

Common mode noise : +/- 1500V (300 nano-seconds)

● I/O line

Normal mode noise : +/- 200V (300 nano-seconds) – in 24V circuits

Common mode noise : +/- 500V (200 nano-seconds) – in 24V circuits

● Static electricity : +/- 1300V

● Radiation noise : +/- 500V

● Ground noise : +/- 1000V (300 nano-seconds)

8. SCOPE OF QUOTATION AND CONSTRUCTION

8.1 Scope of quotation and construction in this specification

The quotation covers the design, fabrication, inspection of the equipment and components mentioned in Items 1 through 5, export packing, and transportation to point of delivery (DDU NDL). Items excluded from this quotation are as follows (should ULVAC be requested to perform any or all of these functions, a separate quotation can be provided):

1) Construction of facilities, foundations, and Earth lines in customer's site.
2) Electric wiring of primary lines, water piping, Air/Vacuum/Gas piping in customer's facilities.
3) Equipment and construction except for described in 5.
4) Production and payment of sputtering targets with bonding.
5) materials for tests, wafers, equipment in clean room, and cost of utility consumption used for installation.
6) Equipment and construction which are not described in this specification.
7) Cost for changing this specification to another specification.
8) Cost for FA/CIM software

8.2 Entron system start-up support

ULVAC engineers support the following for the system at a customer's site before starting installation:

1) Opening packages, checking parts, checking damages
2) Observation of move-in and set for system.
3) connecting vacuum pipes and electric wiring between main system and pump rack

8.3 Installation of Entron on customer's site

After completion of 8-2., ULVAC engineers will install the Entron system (start up, movement check, transfer adjustment, and performance check). Basically, though the system during installation shall be operated by ULVAC engineers, temporary operation training will be available as required and if necessary. However, ULVAC provides official training (operation, maintenance) after completion of the installation.

8.4 Scope of responsibility

In the following list, items described “ULVAC” on STATUS line shall be delivered or construct under ULVAC responsibility. So please provide and prepare items described “CUSTOMER” on STATUS line under customer’s responsibility. Another items shall be determined by conferences.

ITEM SUBJECT STATUS

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1. Cost of shipping and transportation ULVAC

   (delivery from ULVAC factory to customer’s site)

2. Cost of set-up

   1) opening package and checking parts..ULVAC

   2) system move-in to clean room..CUSTOMER

   3) level adjustment after positioning system..ULVAC

   4) connection of utility

   4)-1 Electric wiring <equipment> - Step-down transformer (if necessary)CUSTOMER

   <materials> - between facility and Entron ....CUSTOMER

   -all secondary line in Entron ....ULVAC

   <construction> - between facility and Entron ....CUSTOMER

   - all secondary line in Entron.................ULVAC

   4)-2 water supply system <equipment> Clean chiller unit for system ....CUSTOMER

   F3 chiller unit ....ULVAC

   <materials> - between facility and Entron ....CUSTOMER

   -all secondary piping in system ....ULVAC

   - between chiller and system ....CUSTOMER

   - between chiller and facility................CUSTOMER

   <construction> - between facility and Entron ....CUSTOMER

   - all secondary piping in system ....ULVAC

   - between chiller and system ....CUSTOMER

   4)-3 process gas supply system (including purge nitrogen and vent nitrogen)

   <materials> - between facility and Entron......................CUSTOMER

   - all secondary piping with devices ....ULVAC

   <construction> - between facility and Entron ....CUSTOMER

- all secondary piping with devices ....ULVAC

4)-4 compressed air supply system

<materials> - between facility and Entron ....CUSTOMER

- all secondary piping ....ULVAC

<construction> - between facility and Entron ....CUSTOMER

- all secondary piping ....ULVAC

4)-5 Vacuum piping <materials> - between main system and pump rack ....CUSTOMER

- inside of both main system and pump rack.................ULVAC

<construction> - between main system and pump rack

with leak test...CUSTOMER

- inside of both main system and pump rack

With leak test ....ULVAC

4)-6 Exhaust piping <materials> - between facility and pump rack ....CUSTOMER

- Inside of pump rack...ULVAC

<construction> - between facility and pump rack ....CUSTOMER

- Inside of pump rack...ULVAC

3. maintenance and repair during installation

- repair of Entron, fundamental maintenance ....ULVAC

- repair of damage and parts exchange by customer's responsibility ....ULVAC

(caution! : this item will be charged to customer)

4. consumable parts during installation

- general consumable parts (including spare parts) ....ULVAC

- sputtering targets for both FAT and SAT..CUSTOMER

- test wafers for both dummy and samples...CUSTOMER

- cost of utility (electricity, gases, water, air etc.) ....CUSTOMER

- equipment performed in clean room (clean wear, globes, wipers, etc.)..........CUSTOMER

9. AVAILABLE DOCUMENTS

The following documents are delivered with the Entron system:

1) official system drawings (including layout, utility).. 1 set

2) instruction manuals .... 2 sets

one set is clean-room paper and the second set on compact disk.

(Venders manual and drawing are only clean-room paper.)

- system manual
- operation manual
- computer manual
- error message guide
- maintenance manual
- vendors manual
- drawings for maintenance, lists (electrical drawings, assembly drawings, and spare parts list)

3) FAT data and SAT data .... .each 2 sets

10. CONDITION OF ACCEPTANCE

It is requested that the customer signs acceptance after completion of both FAT and SAT. In both tests, all performance described in Item 4 shall be completed. Installation at the customer site will be completed after system start-up, SAT, and confirmation of accurate operation. The system shall be accepted when it is verified at an inspection that the performance (design basis) in Item 3 is met and the tests conducted at the customer's site is completed (contents of tests at ULVAC are subject to change based on discussions between the two parties).

11. WARRANTY

Warranty period of this system is for 12 months after the sign-off for acceptance. All consumable parts are out of warranty.

12. REMARKS

12.1 Customer supplied parts

12.1.1 Sputtering supplied parts.

Any cost for production of target and bonding are not included in the quotation of this specification.

Customer should provide the required targets for ULVAC inspection and installation after bonding.

12.1.2 Foup for load-port on EFEM(Wafer carrier)

Any cost for SMIF carrier to be used on the load-port of this system is not included in the quotation of this specification. Customer should provide the required carrier for ULVAC inspection and installation after bonding.

12.2 HOTPLATE with ESC

Generally, ULVAC tunes the optimized de-chuck and release time after sputtering step using following factors:

- Silicon wafer coated all surface with SiO_2 (the thickness is 100nm)
- loading voltage of ESC is 0.6kV (+/-0.3kV)

If customer requires different conditions from above, ULVAC will support customer can adjust and optimize them so that wafer can be de-chucked and released as smooth as same as above condition.

12.3 Any items which are not described in this document

Matters not mentioned in this Specification shall be settled through discussion between the two parties and the decision shall take precedence over this Specification, provided that it is confirmed in writing by minutes of meeting or other documents.

- END OF THIS SPECIFICATION –

History of Revisions

Date revised	Revision No.	Content and reasons for revision	Prepared by	Approved by
20, May.'11	01	New edition		

* The history of revisions must always be attached to the end of a specification as the last page.