

Product Specification

产品规格书

SI 500 Inductively Coupled Plasma Etch System 感应耦合等离子刻蚀机



1 General description 产品概述

Inductively coupled plasma etcher **SI 500** is designed for production, research and development, and for use in universities. It enables the proportional transfer of mask structures into silicon and further semiconductor materials, into quartz and related materials with high uniformity as well as the fabrication of binary micro-optical structures on substrates up to 8" size.

感应耦合等离子刻蚀机 **SI 500** 适用于生产和研发、以及用于高校。**SI 500** 可按掩膜结构成比例、高均匀性地刻蚀硅和其他半导体、石英和相关材料，以及实现微光学结构的制备，衬底尺寸最大 8 吋。

Outstanding features of the **SI 500** are the planar inductively coupled plasma (ICP) source and the substrate electrode with helium backside cooling and dynamic temperature control, the high conductance vacuum system and the control concept of the system. The **SI 500** is operated by SENTECH software in combination with a remote field controller (RFC). A proprietary inductively coupled plasma source **PTSA 200** (Planar Triple Spiral Antenna) generates highly dissociated plasma. It is driven by a 13.56 MHz generator that generates plasma densities up to $1E+12 \text{ cm}^{-3}$ at a low plasma potential. An automated matching network is integrated.

SI 500 的显著特点包括平板电感耦合等离子体 (ICP) 源、下电极配置背氦冷却和动态温度控制、高传导真空系统和系统的控制原理。**SI 500** 由 SENTECH 软件结合远程现场控制器 (RFC) 控制。独家的电感耦合等离子体源 **PTSA 200** (平板三螺旋天线) 生成高解离等离子体。它由 13.56 MHz 的功率源驱动、可在很低的等离子体势能下、产生高达 $1E+12 \text{ cm}^{-3}$ 的等离子体密度。自动匹配网络集成在 PTSA 200 中。

The substrate electrode accepts substrates of up to 8" diameter and 9 mm height. Pieces can be handled by carrier. The electrode temperature can be controlled dynamically between -30°C and $+250^{\circ}\text{C}$. To maintain a low substrate temperature even at high plasma densities, a controlled helium pressure is applied to the wafer backside. The wafers are mechanically clamped. A second 13.56 MHz generator supplies the power to the substrate electrode for RF biasing. In this way the ion energy and the ion density can be controlled independently. Applying the RF power to the substrate electrode only, the system looks similar to a parallel plate etcher and allows RIE etching processes.

下电极可容纳最大 8 吋直径、9 mm 高度的衬底，碎片可由载片器装载。电极温度可在 -30°C 到 $+250^{\circ}\text{C}$ 范围内动态控制。为在高密度等离子体中保持衬底的低温，晶圆背面是压力可控的氦气。晶圆由机械压盘夹持。第二个 13.56 MHz 的功率源提供下电极的射频偏置。这样离子能量和离子密度可分别控制。为下电极单独提供射频功率时，系统则与平行板刻蚀机类似、可运行反应离子刻蚀 RIE 工艺。

The vacuum system with a turbo molecular pump and a rotary pump is designed for the low pressure / high flow requirements of the ICP processes and the corrosiveness of fluorine and chlorine chemistry. An automatic throttle valve maintains the pressure in the reaction chamber independent of the gas flow. Mass flow controllers (MFC) provide highly constant flow rates. Thus, well defined and reproducible etching conditions are achieved.

真空系统包括涡轮分子泵和机械前级泵、符合 ICP 工艺所需的低压力/高流量要求、并防止氟基和氯基气体的腐蚀作用。自动节流阀保持反应腔体内的压力、独立于气体流量。质量流量计 (MFC) 提供高稳定的气流。这样就能达到精确和可重复的刻蚀条件。

Wafers are loaded via the vacuum load lock. Wafer carriers might be used for pieces and smaller wafers. A pick-and-place system with pneumatically driven lift pins enables clean and careful

substrate handling. Programmable purging cycles for the load lock ensure operators safety and chamber cleanliness.

晶圆通过预真空室装载。碎片和更小的晶圆可使用载片器。带气动升降杆的拾-取系统保证了清洁和安全的衬底操作。可编程的预真空室吹扫循环保证了操作者的安全和腔室的洁净。

The system is controlled by advanced hard- and software with client-server architecture. A well-proven, reliable remote field controller (RFC) is used for the real time control of all components via the serial field bus (Interbus). Basic security switch offs are realized by this RFC.

系统具备先进的硬件和软件控制系统，采用客户机-服务器结构。成熟、可靠的远程现场控制器（RFC）通过串行现场总线（Interbus）、用于实时控制所有部件。基本的安全切断由该 RFC 控制器实现。

A state of the art PC with Windows operating system is executing the plasma process technology operating software. It provides plasma tool and process visualization, process control, software interlocks against operator errors, and for a lot of comfortable tools. The server communicates with the RFC by Ethernet. Clients may communicate with the server by LAN (local area network) or Internet. The intuitive user interface allows quick and flexible writing, realization and monitoring of etching recipes in automatic mode.

最新型的、配置 Windows 操作系统的 PC 机上运行等离子工艺操作软件，提供等离子工具和工艺状态显示、工艺控制、防止操作者错误的软件互锁、以及大量方便的工具。服务器通过以太网和 RFC 控制器通信。客户机可通过局域网 LAN 或互联网与服务器通信。直观的用户界面，可在自动模式下快速、灵活地编写、实现和监测刻蚀处方 Recipe。

The **SI 500** inductively coupled plasma etcher consists of the following modules:

SI 500 感应耦合等离子刻蚀机包括如下模块：

- **Reactor unit with vacuum load lock and gas box**
反应单元，带预真空室和气路柜
- **Control rack with computer, electronics, monitor and keyboard**
控制机柜，带电脑、电路、显示器和键盘
- **Backing pumps**
前级泵
- **Heat exchange unit for substrate electrode**
热交换器，用于下电极冷却
- **Mains connection box**
配电箱

2 Reactor unit 反应单元

2.1 Reaction chamber 反应腔

The inner cylindrical process chamber is made from a monolithic aluminum ingot. The absence of welding seams contributes to the low leakage.

内圆柱形的反应工艺腔室由整块铝锭制成，没有焊缝、保证了低的真空漏率。

- Material: AlMg4.5Mn0.7
材料: 铝镁锰合金 AlMg4.5Mn0.7
- Upper flange with mounted **PTSA 200** plasma source, movable vertically by lift
上部法兰, 安装 **PTSA 200** 电感耦合等离子体 ICP 源, 通过升降机垂直移动
- Front flange for the slit valve 32 mm x 222 mm to the load lock
正面法兰, 安装 32 mm x 222 mm 闸阀、与预真空室连接
- Side flange DN 200 for the vacuum system
侧面法兰 DN 200, 用于真空系统 (涡轮分子泵)
- Flanges 3x DN 40, one of them with viewport (glass with RF protection)
3 个 DN 40 法兰, 其中 1 个带观察窗口 (带射频保护的玻璃)
- Flange DN 16 for the Baratron
DN 16 法兰, 用于 Baratron 电容真空计
- Leakage rate @ room temperature < 2E-4 mbar l/s
真空漏率@室温 < 2E-4 mbar l/s

2.2 Substrate electrode

下电极

The substrate electrode is equipped with lift pins and clamping mechanism. The substrate plate is surrounded by a dark shield. The temperature of the substrate electrode is measured by a thermocouple within the substrate plate. A fiber-optic temperature sensor at the wafer backside is optional.

下电极配置顶杆和机械卡盘。下电极板周围有无光护罩。下电极温度通过下电极板中的热电偶进行测量。可选在晶圆背面的光纤-光学温度探头。

The temperature of the substrate electrode, settable by software, is actively controlled using a resistance heating against the external liquid cooling circuit. So, the substrate temperature range depends on the temperature range of the external chiller. Standard is a closed cycle heat exchanger (electrode temperature: RT to +250°C). Other chillers are optionally available.

通过软件可设置下电极的温度, 并采用电阻加热、外置液体回路冷却进行主动控制。所以下电极温度范围取决于外部循环温控器 (冷水机) 的温度范围。标准配置是闭环热交换器 (电极温度: 室温~+250°C)。其他循环温控器为可选项。

- Wafer / carrier diameter: 8" / 200 mm, pieces on carrier
晶圆/载片器直径: 8 吋 / 200 mm, 碎片放于载片器上
也可配置成直接放置 3 吋、4 吋或 6 吋晶圆
- Carrier: aluminum, uncoated
载片器: 铝制
- Clamping (Al₂O₃): mechanical ring clamping,
edge exclusion: 3, 4, 7 or 2.5 mm for direct
handling of 3", 4", 6" or 8" wafers resp.
special sizes and exclusions on request (optional)
卡盘 (陶瓷): 机械卡盘环
边缘夹持部分: 3、4、7 或者 2.5 mm, 用于直接
放置 3 吋、4 吋、6 吋或 8 吋晶圆
可定制特殊尺寸和去边夹持 (可选项)
- Substrate plate: insulated, RF biased
下电极板: 绝缘, 射频偏置

- Electrode-source distance: variable, in steps of 50 mm (optional)
电极-ICP 源间距: 可变, 按 50 mm 间距步进 (可选)
- Helium backside pressure: 5 to 12 mbar
氦气背冷压力: 5 - 12 mbar
- Wafer Helium seal: polymer lip seal
晶圆氦气密封圈: 聚合物唇形密封
- Electrode temperature range: -20°C to +250°C (-30°C optional)
电极温度范围: -20°C...+250°C (选配-30°C)

2.3 Vacuum system

真空系统

Pumping speed and conductivity of the vacuum system are matched to standard etching processes for silicon, III-V-compounds and other materials.

真空抽速和真空系统传导性适合于标准的硅、三五族化合物和其他材料的刻蚀工艺。

- Turbo molecular pump
涡轮分子泵
 - Magnetically levitated turbo pump ATH 1600 MT (Pfeiffer Vacuum)
型号 ATH 1600 MT, 磁悬浮涡轮分子泵 (德国普发)
 - 1360 l/sec
抽速 1360 升/秒
 - Anticorrosive design
防腐蚀设计
 - Water-cooled
水冷
- Backing pump Trivac D 25 BCS-PFPE (Leybold)
前级泵 Trivac D 25 BCS-PFPE (德国莱宝公司)
 - 25 m³/h
抽速 25 立方米/小时
 - Resistant against corrosive gases
防腐蚀气体
 - Fomblin filled
Fomblin 充满
 - CFS chemical filter
CFS 化学过滤器
 - ARS demister with oil return
ARS 除雾器带回油
 - IGS inert gas purge system
IGS 惰性气体吹扫系统
- Stepping motor driven throttle valve DN 200
步进电机驱动节流阀 DN 200
- Penning vacuum gauge
潘宁真空规
- Base pressure < 1E-6 mbar
本底真空 < 1E-6 mbar
- Baratron pressure sensor, 0.1 Torr F.S. with 0.001% of F.S. resolution
Baratron 薄膜电容真空计, 满量程 0.1 托, 分辨率 0.001%满量程

2.4 Gas supply system

气路系统

The gas box contains the mass flow controllers (MFCs) and the cut off valves. It is located in the reactor unit next to the chamber. Short distance of ~1.5 m between gas box and reaction chamber allows fast switching between process gases.

气路柜包括质量流量计 MFC 和截止阀，安置于反应单元内、紧挨着反应腔。气路柜和反应腔之间约 1.5 米的短距离保证了工艺气体间的快速切换。

The gas panel usually includes four lines, each equipped with a particle filter and controlled by a MFC. Corrosive gas lines are equipped with bypasses and can be cut off at the input. If more lines are needed a larger panel can be chosen (optional).

气路面板通常包括四路，每路配置颗粒过滤器、并由质量流量计（MFC）控制。腐蚀性气体配备旁路、可在输入端截止。如果需要更多的气路，可选择更大的气路面板（可选项）。

All lines can be cut off separately by normally closed pneumatic valves. The stainless steel electro-polished lines (6 mm outer diameter) are orbital-welded and coupled with VCR connectors. The control range of each MFC is selected according to the processes to be performed. The set points of the MFCs can be adjusted from the user interface. The screen visualizes the set points as well as the actual flow rates. Chosen chamber pressure is automatically maintained by a throttle valve independent of the total flow rate.

所有气路可通过常闭的气动阀门截止。不锈钢电抛光管（外径 6 mm）与 VCR 接头通过星形焊接。按照要实现的工艺选择每个 MFC 的控制范围。可从用户界面上调整 MFC 的设置点。屏幕上同时显示设置点和实际气流量。通过节流阀自动维持所选择的腔体压力值、独立于总的气流量。

The gas box is connected via a gas line with a gas ring which is a part of the reaction chamber wall directly below the source. The gas box has to be connected to the exhaust system. This is strongly required when toxic gases are used for the etching (e.g. Cl₂, HBr, SiCl₄, BCl₃ ...).

气路柜与气体环通过管线连接，气体环是反应腔体的一部分、位于 ICP 源下方。气路柜应该连接到排风系统；使用有毒气体（例如 Cl₂、HBr、SiCl₄、BCl₃ 等）进行刻蚀时强烈要求此连接。

2.5 ICP source PTSA 200

ICP 源 PTSA 200

The ICP source uses a planar triple spiral antenna to couple the RF into the plasma through an Al₂O₃ window covered with a quartz plate. This principle allows higher power transfer to the plasma at low electrical field strengths orthogonal to the chamber walls. The **PTSA 200** generates a highly dissociated plasma and is specially designed for high uniformity and low particle generation.

电感耦合等离子体 ICP 源采用平板三螺旋天线、通过覆盖石英板的氧化铝窗口将射频功率耦合到等离子体中。该原理可在正交于腔体侧壁的方向上，在低电场强度下、将高功率传递到等离子体。

PTSA 200 产生高解离的等离子体、特别设计成高同质、低粒子生成。

Because of the reliable ignition behaviour at low pressures and excellent homogeneity the source is particular suitable for anisotropic high rate etching. An integrated automatic matching network matches the plasma load to the 50 Ohm output impedance of the RF generator.

由于在低压下具有稳定可靠的起辉性能、等离子体具有出色的均匀性，该 ICP 源特别适用于各向异性的高速率刻蚀。集成的自动匹配网络将等离子体负载自动匹配到射频发生器的 50 欧姆输出阻抗。

For optical diagnostics especially with the **laser endpoint detector** a sapphire window in the alumina plate which separates the antenna from the plasma is optionally available.

为使用光学诊断、特别是激光终点检测器，分开天线和等离子体的铝板中可选一个蓝宝石窗口。

- pressure range 0.002 ... 0.1 mbar
压力范围 0.002 ~ 0.1 mbar
- RF power range 100 ... 1200 W
射频功率范围 100 ~ 1200 W
- Plasma density up to $1E+12 \text{ cm}^{-3}$
等离子体密度 可达 $1E+12 \text{ cm}^{-3}$
- Homogeneity $< \pm 5\%$ (6")
均匀度 $< \pm 5\%$ (6 吋)
- Electron temperature $\leq 3 \text{ eV}$
电子温度 $\leq 3 \text{ eV}$
- Minimum ion energy 10 eV
最小离子能量 10 eV
- Water cooled
水冷

2.6 RF power supply 射频功率源

One RF generator is used for RF biasing of the substrate electrode, a second one drives the PTSA source.

一个射频源用于下电极的射频偏置，另一个射频源用于驱动 PTSA 源。

Bias generator 偏置发生器

- 13.56 MHz, 600 W
- Switched-mode power supply
开关电源
- Pre-selection and control of forward power or bias voltage
可预选和控制正向功率或偏置电压
- Measuring and visualization of forward, reflected power and dc bias voltage
测量和显示正向功率、反射功率和直流偏置电压
- Automatic matching network
自动匹配网络
- Air cooled
空气冷却

ICP generator ICP 发生器

- 13.56 MHz, 1,200 W
- Switched-mode power supply
开关电源
- Pre-selection and control of forward power
可预选和控制正向功率
- Measuring and visualization of forward and reflected power
测量和显示正向功率和反射功率

- Air cooled
空气冷却

2.7 Vacuum load lock

预真空室

The compact load lock chamber is made from a monolithic aluminium ingot and connected to the reactor chamber by a rectangular SEMI-MESC gate valve 32 mm x 222 mm. It is equipped with a pneumatic transfer mechanism and an aluminum lid with an observation window. Loading and unloading are performed automatically. The load lock is evacuated via a soft pump valve, and purged with nitrogen, respectively.

紧凑的预真空室腔体由整块铝锭制成、通过矩形 SEMI-MESC 闸阀 32 mm x 222 mm 与反应腔室连接，配置气动的传送机构和带观察窗的铝盖，自动执行样品的装卸。预真空室通过平稳起动的泵阀排空，并可单独用氮气吹扫。

- Chamber material: AlMgSi1
腔体材料: AlMgSi1
- Volume: approx. 7 l
容积: 约 7 升
- Gate valve: rectangular, 32 mm x 222 mm
闸阀: 矩形, 32 mm x 222 mm
- Seals: Viton O-rings
密封: Viton, O 型密封圈
- Vacuum: dry rotary pump e.g. ACP 15
真空: 干泵, 例如 ACP 15
- Pressure sensor: Pirani gauge
真空计: 皮拉尼真空规
- Base pressure: < 0.1 mbar
本底真空: < 0.1 mbar
- Leakage rate: < 5E-4 mbar l/s
真空漏率: < 5E-4 mbar l/s
- Approximate cycle times: Wafer insert ~ 120 sec (including evacuation)
Wafer retract ~ 60 sec (including ventilation)
粗略循环时间: 晶圆进入约 120 秒 (包括排空时间)
晶圆退出约 60 秒 (包括通风时间)

3 Control system

控制系统

3.1 Hardware

硬件

A remote field controller (RFC) is used for the real time control of all system components via the serial field bus (Interbus). Basic security switch offs prevent damage to the hardware. They are realized by this RFC, which monitors the corresponding conditions independently of the status of the personal computer.

远程现场控制器（RFC）通过串联现场总线（Interbus）实时控制所有系统部件。基本的安全关闭可以预防对系统硬件造成损伤，这些由该 RFC 控制器实现，RFC 同时监测与个人计算机状态独立的系统其他相应状况。

Bus nodes in the control rack and in the reactor module convert the bus commands and the input/output signals of the components, respectively. The architecture enables quick addition or removal of components and extended error diagnostics. The Interbus is one of the fastest and most noise immune serial bus systems and has a protocol stable over years.

控制机柜和反应单元中的总线节点分别转换总线命令和输入/输出信号。这个结构保证了可快速地增加或移去部件、并扩展了错误诊断功能。Interbus 是最快的、不受噪声影响的串联总线系统，而且协议多年稳定。

The plasma process technology operating software is executed on a PC with Windows operating system. It provides plasma tool and process visualization, process control, software interlocks against operator errors and lots of comfortable tools. Its server part communicates with the RFC by Ethernet. Clients may be connected by LAN or Internet. The plasma system software is prepared for the remote service capability allowing fast service access via safe internet connection.

等离子工艺技术操作软件是通过配置 Windows 操作系统的 PC 机实现。它提供了等离子机台和工艺的可视化，同时提供了工艺控制，防止操作错误的软件互锁及一系列便利的工具。它通过以太网和 RFC 控制器联接。客户端可通过局域网 LAN 或互联网联接。等离子工艺软件已具备远程服务能力、可通过安全的互联网联接进行快速服务。

A 19" control rack is located next to the reactor unit. PC, keyboard, and monitor can be placed separately. The rack comprises:

19 吋控制机柜放置于反应单元旁。电脑、键盘和显示器可单独放置。机柜包括：

- PC, monitor and keyboard
电脑、显示器和键盘
- Remote field controller (RFC)
远程现场控制器（RFC）
- RF generators
射频发生器
- Turbo molecular pump controller
涡轮分子泵控制器
- Power supplies
电源
- Transformer for electrode heating
电极加热变压器
- Emergency switch
应急开关

3.2 SENTECH operating Software SENTECH 操作软件

The SENTECH plasma process technology operating software is based on Windows. The user can observe the command execution or the process run on the monitor, following a schematic flow or the data logging graphics. The executed recipe steps are marked and the state of the system is displayed. The settings and the actual values of all analogue parameters are shown. Its user-friendly interface enables quick and comfortable process development and recipe generation.

SENTECH 等离子工艺操作软件基于 Windows 操作系统。用户可以通过示意图流程或数据记录图像来观察指令执行或工艺过程。执行中的工艺处方步骤会被标示，同时也会显示系统状态。所有的设置以及参数的真实数值也会显示。它的用户友好界面实现了快速和方便的工艺研发和工艺处方的生成。

A password controlled user login with flexible user access management is supported. Most commendable are the service mode, the supervisor mode and the operator mode.

系统支持有密码控制的用户登录界面，可实现灵活的用户访问管理。常用到的用户访问模式为服务模式、监管模式和操作员模式。

In manual mode each step can be executed by mouse click. A process executed by a recipe runs automatically unless it is manually interrupted by the user or when a parameter reaches or is beyond the interrupt limits, which can be defined for all parameters. This interrupt performance assures additional safe and, within the limits, very reproducible process.

在手动模式下，每一个工艺步骤可以通过点击鼠标来执行。同样，以处方编辑的工艺可以自动执行，除非被人为影响或是某个参数超过设定极限，这些极限可以有用户来决定。这样的工艺中断保证了额外的安全，并且在极限值范围内实现工艺的高度重复性。

A special recipe editor supports the user in creating or changing recipes or parameter values. The recipe may contain jumps, loops and calls. Using these functions in the recipe e.g. the compliance with the set point values during the run can be controlled. Recipes are stored in data files for later rerun. Support is also given for changing process parameters in dependence on in-situ measured plasma or etch parameters.

特殊的处方编辑功能支持用户创建或改变工艺处方或参数值，处方可包括跳过，循环和访问。使用这些功能可控制例如在工艺过程中的设定值是否在合规范范围内。工艺处方保存于数据文件中，后续可以再次使用。支持根据原位测量结果或刻蚀参数、来改变工艺参数。

An extended data logging records all analogue parameters on the monitor and in ASCII files. Several reactor units can be controlled at the same time and independent on each other. The software is prepared for remote service capability allowing fast service access via save internet connection.

扩展的数据加载功能在显示器上、和在 ASCII 文件中记录所有的相关参数。几个反应单元可同时被软件分别控制。该软件具备远程服务能力，以便通过安全的网络连接得到快速的服务。

4 Mechanical dimensions and utility requirements

机械尺寸和安装要求

Approximate dimensions (width x depth x height) 大概尺寸 (宽 x 深 x 高)

- Reactor unit 685 x 1610 x 1560 mm³ (~ 1700 mm with lifted ICP source)
反应单元 685 x 1610 x 1560 mm³ (~ 1700 mm 高, ICP 源升起)
- Control rack 650 x 800 x 1200 mm³
控制机柜 650 x 800 x 1200 mm³
- Mains connection box 500 x 300 x 500 mm³ (to be mounted on the wall)
配电箱 500 x 300 x 500 mm³ (装于墙上)
- Backing pumps mounted together in a separate rack(if requested,
Only for standard configuration)

D 25 BCS & ACP 15	700 x 630 x 1100 mm ³
Leybold LH D 25 BCS	600 x 700 x 300 mm ³
Pfeiffer ACP15	190 x 520 x 270 mm ³
前级泵	一起装于单独的机柜内 (如有需要, 只适用于标准配置)
D 25 BCS & ACP15	700 x 630 x 1100 mm ³
莱宝 LH D 25 BCS	600 x 700 x 300 mm ³
普发 ACP15	190 x 520 x 270 mm ³

Utility requirements 安装要求

- Power 功率 3x 400 V +/- 5%, 32 A, 50 Hz
- Compressed air 压缩空气 5 to 7 bar (oil and water free) 5 ~ 7 bar (无油、无水)
- Cooling water 冷却水 max. 4 bar (filtered), 6-8 l/min, Temperature 15°C to 25°C colorless, free of oil and grease 最大 4 bar (过滤), 6-8 升/分, 温度 15°C ~ 25°C 无色、无油、无油脂
- Nitrogen 氮气 5 bar, 25 l per run, 3.5~60 slm purge gas depending on pump, process purity 5 bar, 每个工艺 25 升, 吹扫用量依真空泵而定、3.5~60 slm 工艺纯度
- He for back side cooling 氦气 (用于背冷) 2 bar, purity: process requirement, recommended 5.0 2 bar, 纯度: 工艺要求, 建议 5.0
- Exhaust of gas box 气路柜排气口 $\varnothing_{\text{outer}}$ 80 mm, min. 50 m³/h $\varnothing_{\text{outer}}$ 80 mm, 至少 50 立方米/小时
- Exhaust backing pumps 前级泵排气口 DN 25 KF / DN 16 KF DN 25 KF / DN 16 KF
- Gas-lines to cabinet 到气瓶柜的气体管道 electro-polished stainless steel tube, 1/4" VCR 电抛光不锈钢管, 1/4" VCR

Approximate mass 大概质量

- Reactor unit 反应单元 270 kg
- Control rack 控制机柜 120 kg
- Pump module 泵组 150 kg
- Mains connection box 配电箱 30 kg
- Heat exchange unit 热交换器 14 kg

The equipment can be installed "through the wall" between clean and service areas of a clean room.

设备可在洁净室的洁净区和服务区(灰区)之间“穿墙式”安装。

5 System options 选项

- “Through The Wall” installation between clean room and service area
在洁净室和服务区（灰区）之间的“穿墙式”安装
- Extra gas lines, extra gas box
增加的气路，增加的气路柜
- Inlet valves for noncorrosive gas lines
非腐蚀气路的进口阀
- Circulator thermostat FP 40 (680 W @ 20°C, 500 W @ 0°C, 320 W @ -20°C of cooling power)
循环恒温器（冷水机），FP 40，冷却功率 680 W @ 20°C, 500 W @ 0°C, 320 W @ -20°C
- Alternative turbo molecular pumps(Leybold) on request
可要求替代的涡轮分子泵（莱宝）
- Dry pump in lieu of rotary vane backing pump
前级机械泵替换成干泵
 - A 124 H, 110 m³/h (Pfeiffer)
型号 A 124 H, 抽速 110 立方米/小时（普发）
 - EV-S20 P/N, 100 m³/h (Ebara)
型号 EV-S20 P/N, 抽速 100 立方米/小时（荏原）
- Edwards pump set
Edwards 真空泵组
 - STA-A1603C turbo molecular pump, 1600 l/sec
STA-A1603C 涡轮分子泵，抽速 1600 升/秒
 - IGX100N dry pump, 100 m³/h
IGX100N 前级干泵，抽速 100 立方米/小时
 - nXDS15i scroll pump, 15 m³/h
nXDS15i 滚动泵、抽速 15 立方米/小时
- Variable electrode-source distance (in steps of 50 mm)
可变电极-ICP 源间距（步进值 50 mm）
- Bias generator 13.56MHz, 300W
偏置发生器，300 W
- Electrode for -30°C working temperature (silicon O-rings, reduced chlorine stability)
可在-30°C 温度下工作的电极（硅胶密封圈，降低氯的稳定性）
- Fast throttle valve
快速节流阀
- Isolation or pendulum valve (separation of turbo molecular pump from reaction chamber)
隔离阀或摆阀（将涡轮分子泵从反应腔隔离开）
- Turbo molecular pump set for the load lock including
预真空室用涡轮分子泵，包括
 - Turbo molecular pump Turbovac 50, 33 l/sec, DN 40 (Leybold)
涡轮分子泵 Turbovac 50, 抽速 33 升/秒，DN 40（德国莱宝公司）
 - Isolation valve (separation of turbo molecular pump from load lock)
隔离阀（将涡轮分子泵从预真空室隔离开）
 - Penning gauge
潘宁真空规
- SENTECH Laser endpoint monitor SLI 670 / SLI 980 (laser interferometer)
SENTECH 激光终点监视器 SLI 670 / SLI 980（激光干涉仪）
- Optical emission spectrometer (OES)

- 光学发射光谱仪 (OES)
- Piezo driven digital MFCs
压电驱动数字质量流量计
 - Heated reactor body, maximum temperature 50°C
反应腔体加热, 最高温度 50°C
 - Heated vacuum line between heated turbo molecular pump and dry backing pump, ~100°C
加热真空管, 在加热涡轮分子泵和前级干泵之间, ~100°C
 - Isolation valves for Baratron and Penning pressure gauges
用于薄膜电容真空计和潘宁真空规的隔离阀
 - Liner (aluminum, quartz)
衬套 (铝制、石英)
 - Carrier of various materials (e.g. aluminum platen with aluminum or quartz clamping ring)
不同材料的载片器 (例如铝台板带铝制或石英卡盘压环)
 - Multi-wafer carrier (e.g. 3x 3", 7x 2", others on request)
多片载片器 (例如 3x 3", 7x 2", 其他可定制)
 - Fiber coupled temperature sensor at wafer backside
光纤耦合温度探头、放于晶圆背部
 - Cluster configuration
多腔系统配置
 - Single wafer loading
单片装载
 - C(assette) to C(assette) loading
片盒到片盒装载
 - DRIE-configuration:
深硅刻蚀系统配置
 - Chiller FP51-SL (2 kW @ 20°C, 1.5 kW @ 0°C, 1 kW @ -20°C, 260 W @ -40°C)
冷水机型号 FP51-SL (2 kW @ 20°C, 1.5 kW @ 0°C, 1 kW @ -20°C, 260 W @ -40°C)
 - Dry backing pump A 124 H, 110 m³/h
前级干泵, 型号 A 124 H, 抽速 110 立方米/小时
 - ICP power up to 2000W
可达 2000 W 的 ICP 功率源
 - Fast digital MFCs
快速数字质量流量计
 - Spacer rings (50 mm)
间隔圈 (50 mm)
 - Fast throttle valve
快速节流阀
 - SECS/GEM support
支持 SECS/GEM

6 Footprint 布置图

SI 500 footprint (example):
 SI 500 的平面布置图 (例) :

