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MC-200

DLI

200 mm DLI-CVD/ALD system for R&D

Processes: DLI-CVD, DLI-ALD, Pulse Pressure CVD

Applications

- Simple and multi-metallic oxides
- Metals, nitrides and alloys
- III-V, wide band gap semiconductors
- 2D and 3D materials
- Etc.

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Substrate types

- Mono crystalline wafers for epitaxial deposition
- Silicon wafers
- Compound semiconductor wafers
- Poly silicon wafers for solar cells
- Glass substrates
- Etc…

System advantages

- **Compatibility with a wide range of precursors**
  => High versatility for Research and Development applications
- **State of the art liquid delivery and vaporization system**
  => Capability to vaporize a wide range of chemical precursors
- **No complicated shower head**
  => Capability to use thermally unstable precursors
  => Good deposition uniformity without clogging risk into the shower head
  => Easy cleaning and replacement of the shower head
- **Process gas inlet separated from precursor inlet**
  => No reaction outside of the substrate deposition area, no clogging
- **Optional capacitance plasma substrate holder**
  => Plasma assisted deposition capability to reduce process temperature
- **Easy dismantling, cleaning and installation of the reactor**
  => Easy switching from one material to another, easy service, low COO
- **Full rising capability of the liquid panel**
  => No cross contamination, no need to dismantle liquid lines

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Key features

Versatile system to meet application requirements

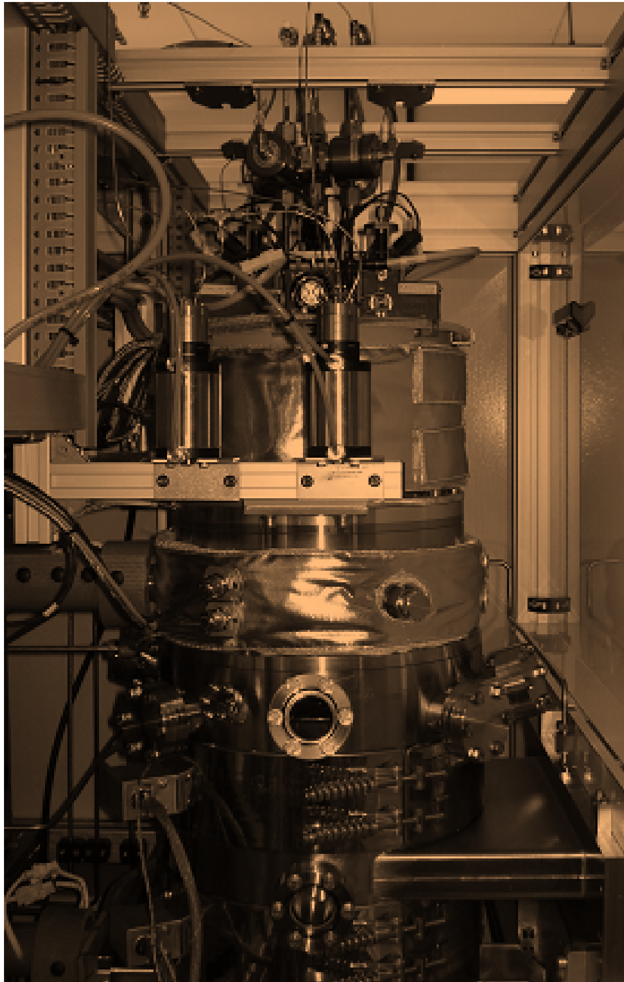
- Direct liquid injection vaporizer for utilization of widest precursor range
- Up to 4 direct liquid injection vaporizer
- ALD capability with low chamber volume when substrate holder is up
- Optional ALD kit for water vapor injection
- Rotating substrate holder for best deposition uniformity in CVD mode
- Substrate holder with vertical motion for enhanced process control
- By-pass for perfect interface control for deposition of nanolaminates
- Optimized organometallic chemical liquid line panel
- Automatic procedure for chemical cleaning of liquid lines
- Optional capacitance plasma for reduced process temperature
- PC control with Ethernet communication

Reactor design

- Stainless steel thermally controlled chamber technology*
- Optimized vaporizer integration
- R&D type shower head for easy cleaning and exchange
- O-ring flange design for easy dismantling and cleaning
- Heating substrate holder up to 800°C
- Heated by-pass valve up to 300°C
- Vertical linear motion mechanism with software control
- Pressure control with throttle valve and capacitance manometer
- Up to 8 process gas lines with digital mass flow controllers
- Purge gas line with needle valve
- Loading by manual manipulator or motorized loadlock

**** See next slide***

Thermally controlled chamber technology



Vaporizer

Mixing Chamber

Heating elements

Shower head

Heating elements

Heating substrate holder

bypass

N_2

Manual loading arm

Vacuum

(optional loadlock)

Door

Rotating feedthrough

Vertical motion of the substrate holder

The wall temperature is controlled up to 300°C to avoid precursor condensation
Only the substrate heater is heated at deposition temperature up to 800°C

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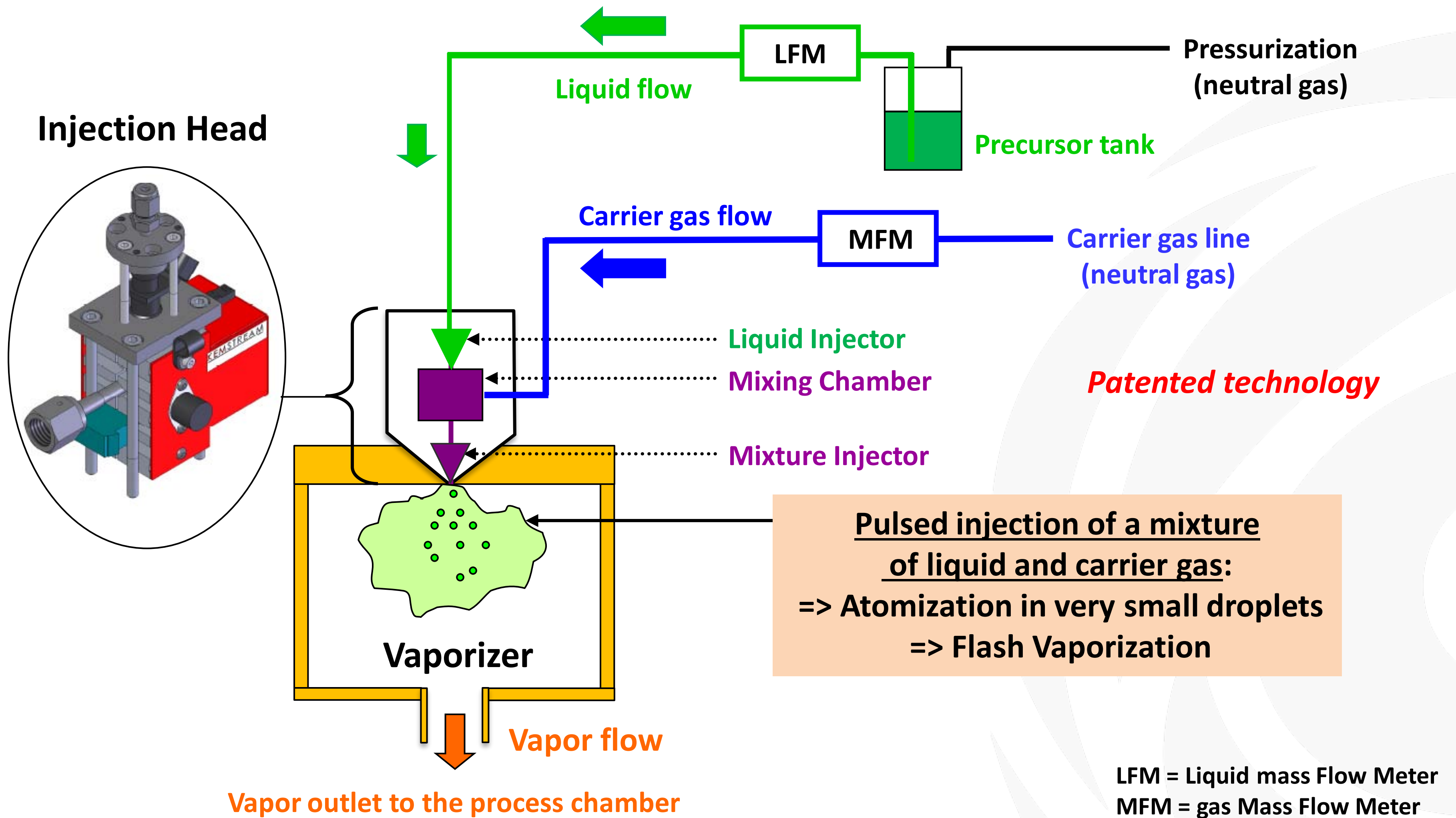
Direct liquid injection: operating principle



Direct liquid injection

The system is provided with Kemstream vaporizer

Perfect vaporizer integration for unique process capabilities

➢ Advantages

- ➢ Perfect control of precursor flow (control of the liquid flow)
- ➢ Precursor tanks remains at room temperature
- ➢ Utilization of thermally unstable chemical precursors
- ➢ Utilization of low vapor pressure chemical precursors (solids)
- ➢ Utilization of diluted chemical precursors
- ➢ Fast vapor switch on/off without flow overshoot
- ➢ Coriolis liquid flow meters (no need for calibration)

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Liquid panels

State of the art liquid panels for precursor handling for direct liquid injection (DLI) vaporizers

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Liquid panels

State of the art liquid panels for precursor handling for direct liquid injection (DLI) vaporizers

- Small tubing volume to save expensive precursors
- Zero dead volumes liquid valves and fittings
- One, two or three precursors configuration
- 2 liquid panels capability for 4 or 6 precursor applications
- Full rising capability
- Fully automatic control for easy chemical management
- Air sensitive precursor handling capability

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Liquid precursor tanks

Optimized precursor tanks with special manifold

- **Proprietary liquid manifold with zero dead volume**
- Complete separation of liquid and gas circuits
- Compact size tank compatible for re-filling in glove box
- Removable lid for easy cleaning
- Different volumes available
- Liquid level sensor option

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Liquid precursor tanks

Liquid precursor tank

The actual volume of the green part is minimized.

The actual volume of the red part is zero. (No precursor dead volume when rinsing)

Solvent

Precursor delivery

Pressurization gas

V1

V2

V3

Special manifold

Removable lid

Sealing

Screws

4-inch tube

Liquid outlet tube (1/8")

Liquid level sensor (optional)

- All valves are diaphragm pneumatic valves
- Tank sealing: Kalrez (other materials upon request)
- Precursor tank volume can be adjusted by changing height
- Optional level sensor

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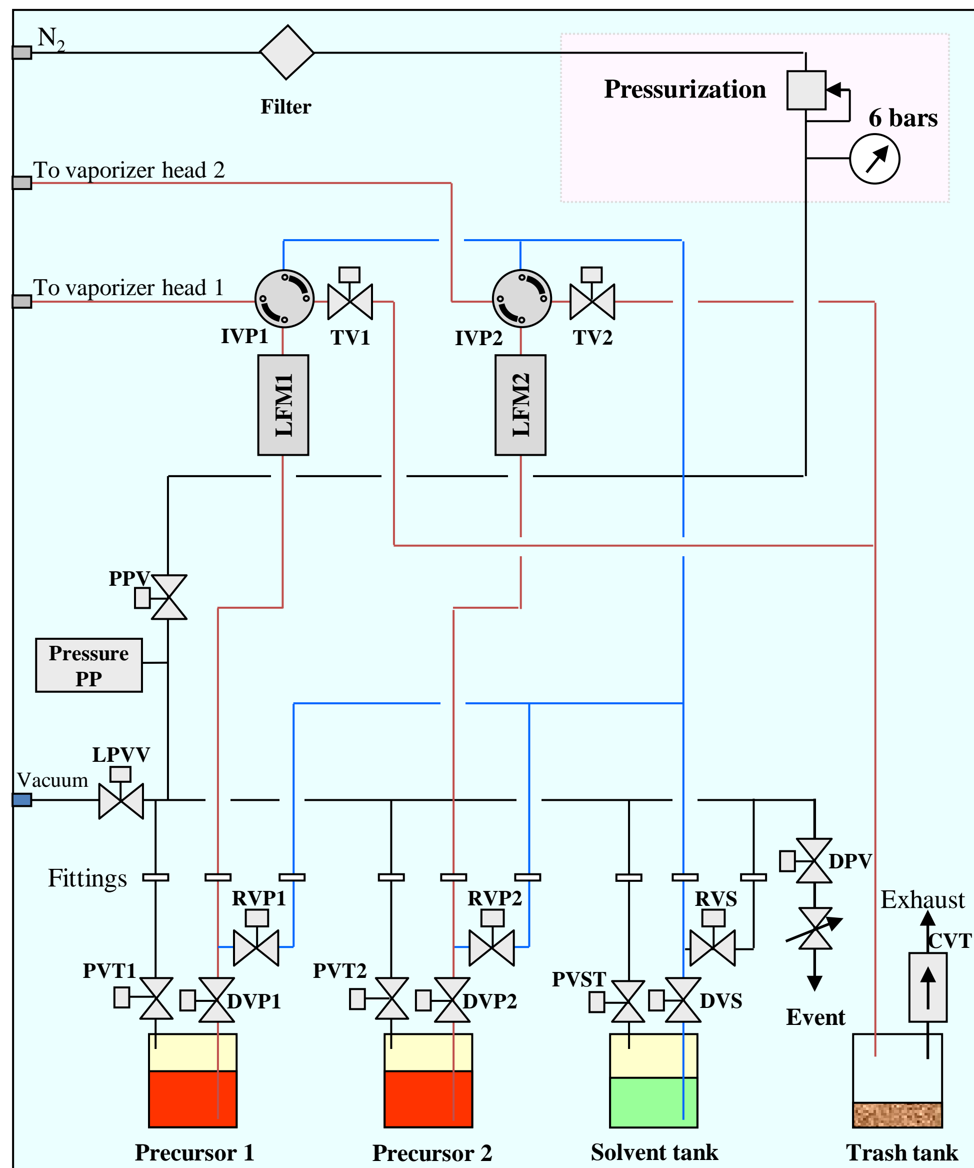
Liquid panels

Designed for:

- Expensive precursors
- Unstable liquid precursors
- Low solubility solid precursors
- Automated control with interlocks

Advantages:

- High protection of liquid flow meter
- Protection of the vaporizer liquid line
- Low precursor losses during rising cycle
- Automatic rising cycles



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Optional features

Warranty extension :	Two years or three years warranty
System:	Optical pyrometer Motorized single wafer loadlock Additional process gas line Capacitance plasma Remote plasma Ozone generator Soft-start vacuum valve
Liquid delivery:	Additional vaporizer or additional injection head Additional liquid line and carrier gas line
Vacuum pump:	Fomblin vacuum pump or dry pump Turbo pump Ballast for vacuum pump
Software:	Wafer traceability
Miscellaneous:	Signal tower Gas abatement system Chiller Spare part kits, Susceptors

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Main software features

Access modes:

Operator, Engineer, Administrator

Recipe mode:

Up to 400 operation per recipe

Capability to integrate macros into recipes

Process:

Full data logging

All data and table saved in process historical

Manual mode:

Manual control of heating, vacuum and gas and chemical precursors

Configuration mode:

Mass flow ranges, calibration tables, alarm values…

Diagnostic mode

Easy troubleshooting

Automatic diagnostic report generation for remote support

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PC Control Software: Step editor for process recipes

Capability to integrate macro functions in the operations: precursor lines conditioning, post recipe cleaning…

CVD Temperatures			Substrate holder	Gas / Pressures			Vaporizer	Liquid panel		Recipe parameters		Machine parameters	
Temperatures (°C)	Setpoint	Readout		Gas (sccm)	Setpoint	Readout	Pressures (mBar)			Recipe time	0.0	Idle	
Mixing chamber	800	536		N2	2000.0	1072.0	Setpoint	5.36E+3		Operation time	0.0	System ON	
Sub. center	800	6		O2	5000.0	1072.0	CAPA_CTL	6.70E+2		Operation N°	0	Process	Idle
Sub. edge	800	265		CF4	1000.0	70.0				Operation type		Chamber	Closed
Reactor top	800	532		H2	200.0	62.0				Operation detail			
Reactor bottom	800	18		NH3	2000.0	1072.0				Recipe name			

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AL2O3 PECVD

N°	Operation type	Operation details	Comment
1	Condition	Waiting for Duration is = 10 s	
2	Macro	AS-Chamber_Pumping	Soft pumping Macro
3	Macro	AS-Heating-deg-150_600	
4	Macro	AS-LiquidLine1.1_Conditionning	
5	Macro	AS-Reactor_Conditionning	
6	Vaporizer	Head1:ON-ON Head2:OFF-OFF Head3:OFF-OFF Head4:OFF-OFF	
7	Condition	Waiting for Duration is = 7200 s	
8	Vaporizer	Head1:OFF-OFF Head2:OFF-OFF Head3:OFF-OFF Head4:OFF-OFF	
9	Macro	AS-Reactor_Post_Deposition	
10	Macro	AS-LiquidLine1.1-Post_Deposition	
11	Macro	AS-LiquidLine1.1_cleaning	
12	Macro	AS-Reactor-Stop	
13			
14			
15			

Operation editor

Header

Operations

< Commands >

Add | Insert | Copy | Delete | Save | Print

Recipes | Process | Historicals | Configuration | Manual Mode | Diagnostics | Shut down

Adm/Administrator

Software version : 3.5.0
PCD Version : 3.5.0

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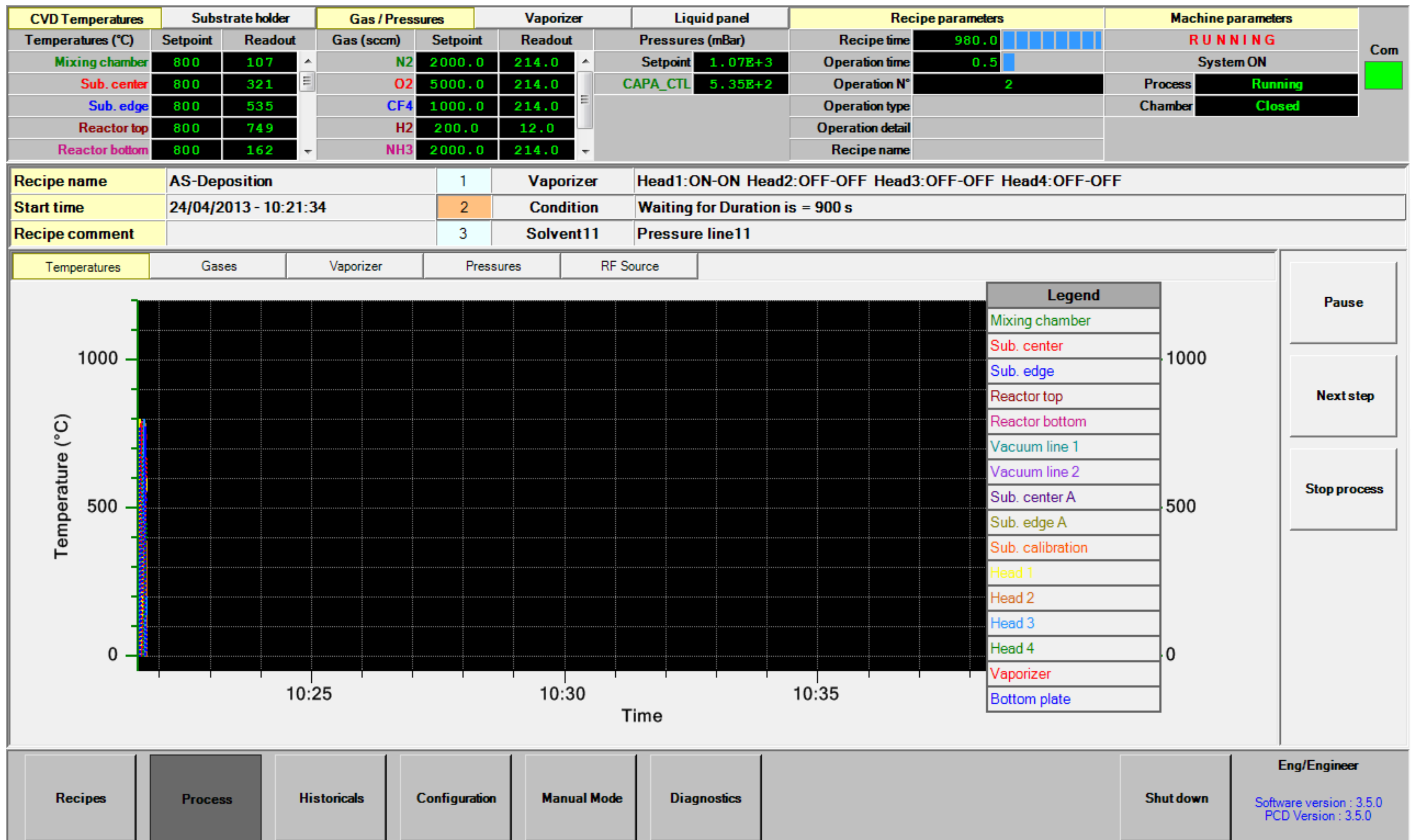
PC Control Software: Real time display and data collection



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PC Control Software: Diagnostic capabilities

CVD Temperatures			Substrate holder	Gas / Pressures			Vaporizer	Liquid panel		Recipe parameters		Machine parameters	

Temperatures (°C)	Setpoint	Readout
Mixing chamber	800	378
Sub. center	800	333
Sub. edge	800	260
Reactor top	800	203
Reactor bottom	800	198

Gas (sccm)	Setpoint	Readout
N2	2000.0	356.0
O2	5000.0	2358.0
CF4	1000.0	354.0
H2	200.0	136.0
NH3	2000.0	356.0

Pressures (mBar)	
Setpoint	1.18E+4
CAPA_CTL	8.70E+2

Recipe parameters	
Recipe time	0.0
Operation time	0.0
Operation N°	0
Operation type	
Operation detail	
Recipe name	

Machine parameters	
Idle	
System ON	
Process	Idle
Chamber	Closed

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States | Inputs | Outputs | Miscellaneous | Alarms

PCD configuration

```
-------------------------------------
System ID          : MC200 STANDARD - 5853
Wiring             : 103
Main PCD version   : 3.2.0
Main PCD firmware  : D3M531160
Number of zones    : 0
Number of currents: 0
RTP Tmp controller: WITHOUT
Number of zonesCVD: 16
CVD Tmp controller: FUJI
Remote oven        : No
RKC Direct         : No
SensorBoard        : No
SensorBoard 2      : No
OPT_PYRO1          : No
OPT_PYRO2          : No
OPT_4_20mA         : No
Double furnace     : No
Number of chambers: 1
Power Ratio        : False
Number of MFM      : 0
Number of MFC      : 6
MFC Type           : REMOTE_LQP1
Gas in Group1      : 0
Gas in Group2      : 0
Vaporizer 1        : KS_VAPORIZER1
Vaporizer 1 mode   : MODE_1
Vaporizer 1 vers. : 0.
Vaporizer 2        : KS_VAPORIZER1
```

Communication	
MFC 1	No on going alarm
MFC 2	No on going alarm
MFC 3	No on going alarm
MFC 4	No on going alarm
MFC 5	No on going alarm
MFC 6	No on going alarm
FUJI 1 read	No on going alarm
FUJI 1 write	No on going alarm
FUJI 2 read	No on going alarm
FUJI 2 write	No on going alarm
FUJI 3 read	No on going alarm
FUJI 3 write	No on going alarm
FUJI 4 read	No on going alarm
FUJI 4 write	No on going alarm
FUJI AI 1 read	No on going alarm
FUJI AI 1 write	No on going alarm
Press. read	No on going alarm
Press. write	No on going alarm
Source read	No on going alarm
Source write	No on going alarm
SP 1 read	No on going alarm
SP 1 write	No on going alarm
Rotation read	No on going alarm
Rotation write	No on going alarm

Currents		
Age of substrate zone	00:00:17	Clear
Power requested (%)	0	

Clear

Make a diagnostic report

Recipes | Process | Historicals | Configuration | Manual Mode | Diagnostics | Shut down

Adm/Administrator

Software version : 3.5.0
PCD Version : 3.5.0

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Specifications

	MC200
Substrate diameter	200 mm
Temperature range	RT to 800°C
Temperature control	PID controllers
Thermocouples	K type
Number of vaporization units	Up to 4
Precursor injection	From pre-deposition chamber
Gas injection	From top deposition chamber
Purge gas line	Standard
Process gas line with MFC	Up to 6
Pumping port	Bottom of the chamber
Vacuum valve and gauge	Standard

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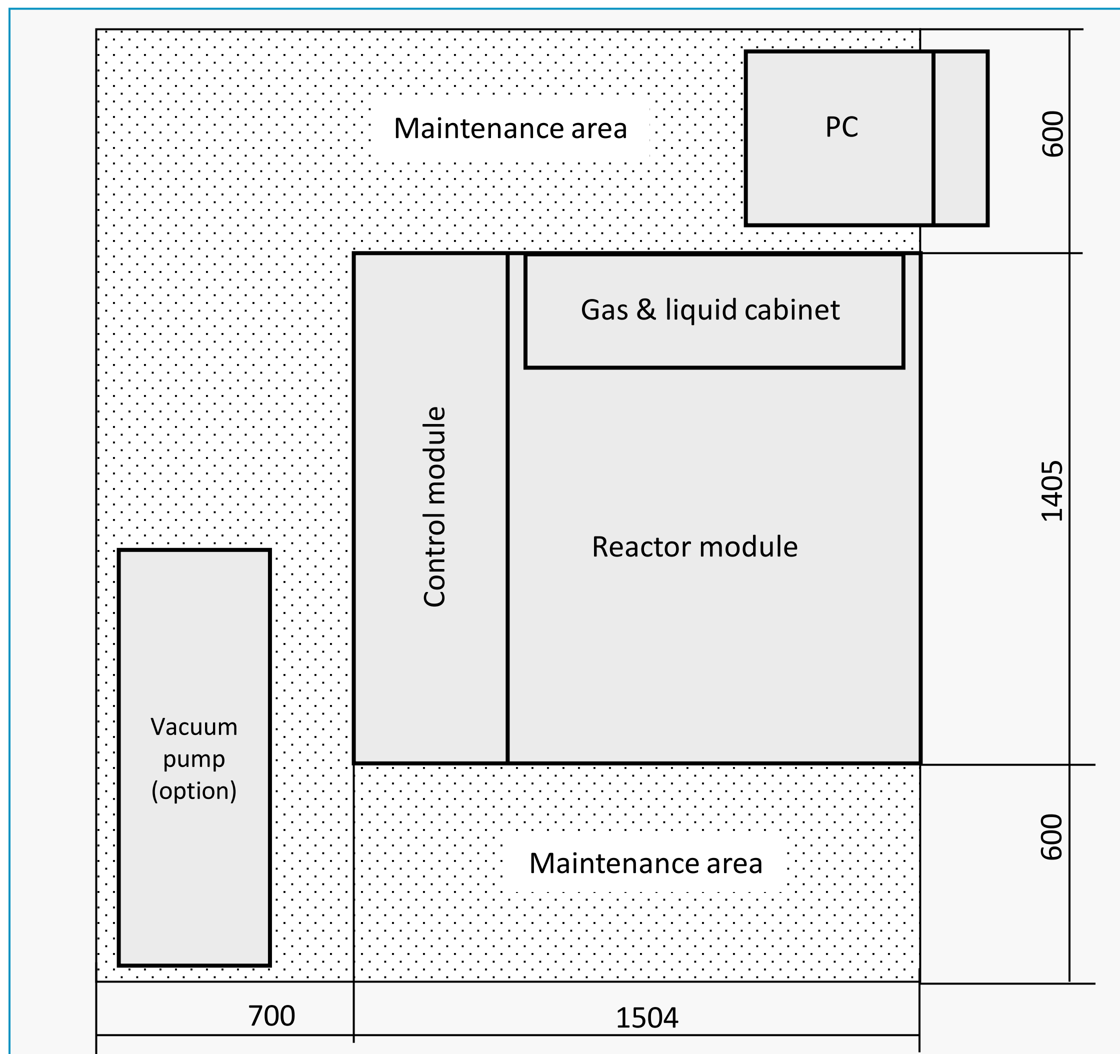
Layout of the machine without the loading system



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Facility requirements

	MC200
Voltage	3x400V+N or 3x220V
Power	20 kW
Water flow	4 l/mn
Compressed air	6 bars / 0.1 m^3/h
Process gases	2 bars
Pressurization gas (for precursors)	7 bars

Dimensions and Weight

	MC200
Width	1,000 mm
Height	2,200 mm
Depth	2,104 mm
Weight	900 kg

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Thank you for your attention

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