

Zenith-150

RTP



**High Temperature
Rapid Thermal Processor
up to 2000°C**

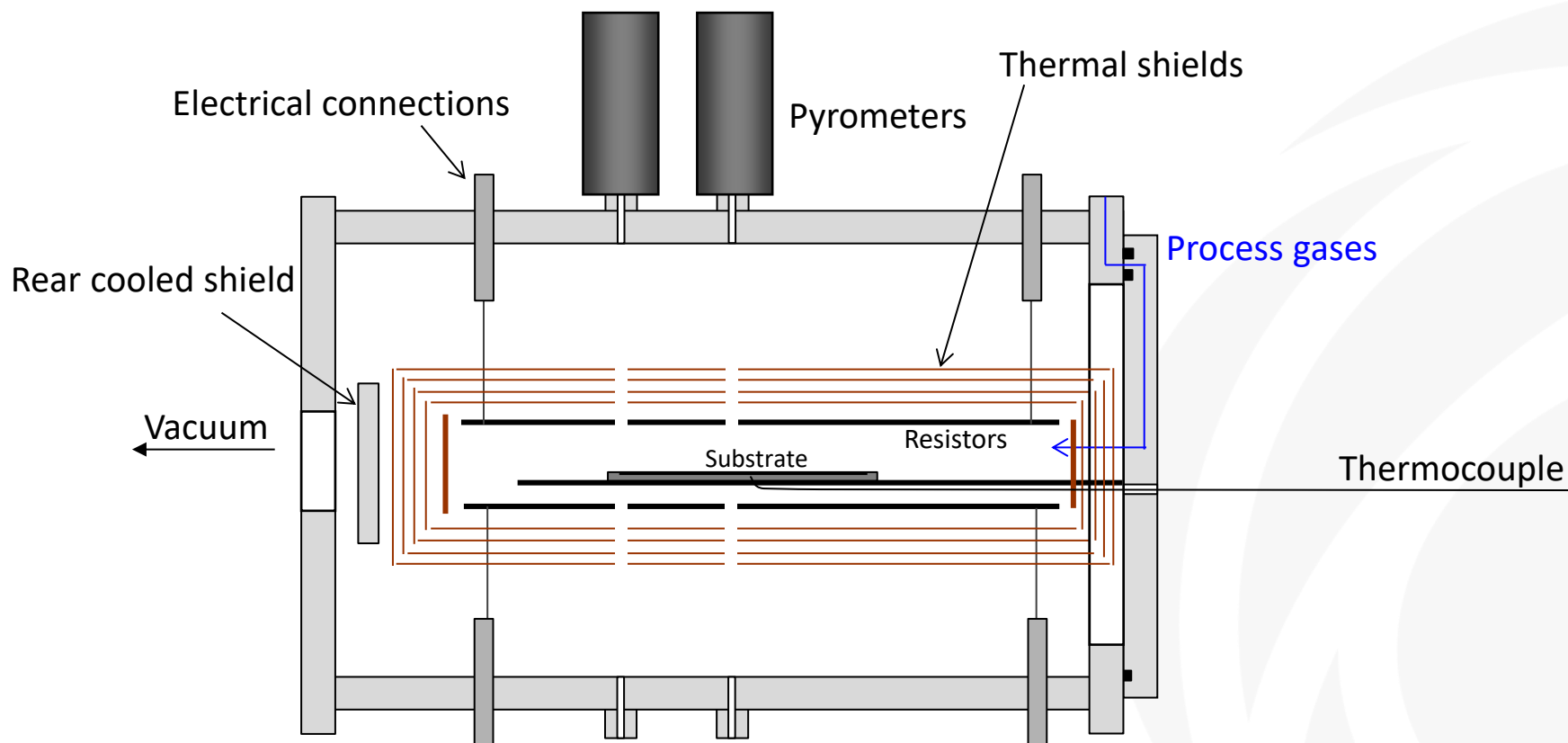
Applications

- **SiC implant annealing**
- **CVD of graphene**
- **Graphene by high temperature SiC sublimation**
- **Etc.**

Key Features

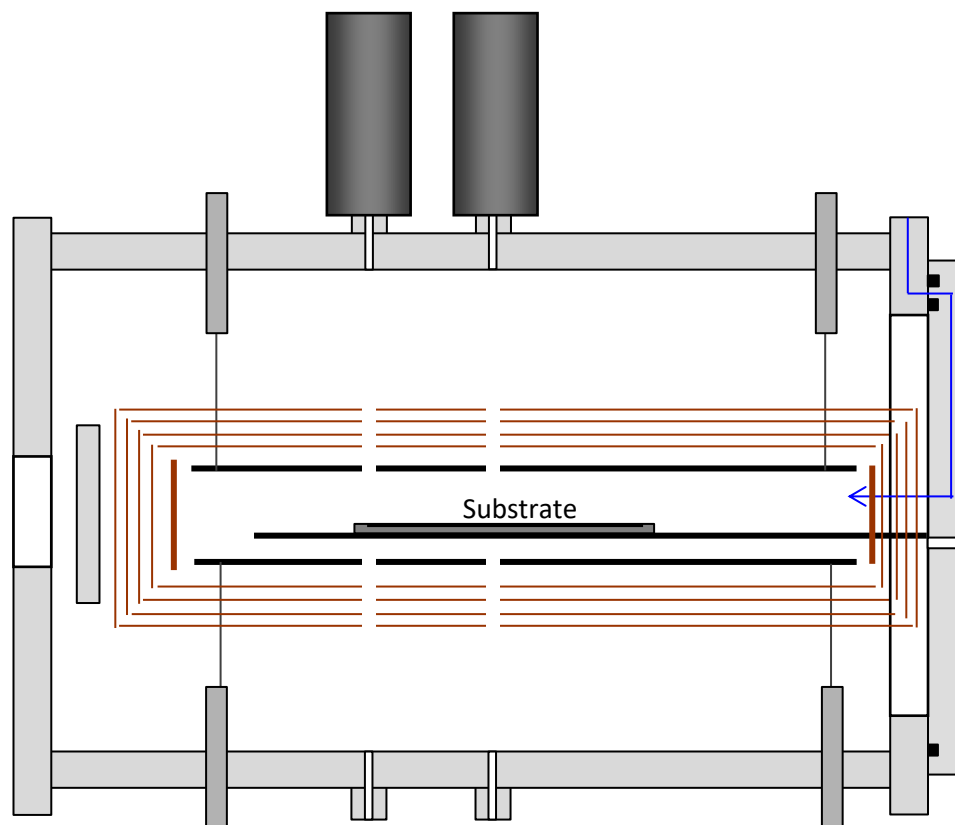
- Tungsten heater furnace
- Stainless steel cold wall chamber
- Easy substrate loading
- Fast digital PID temperature controller
- Pyrometer temperature control
- Atmospheric and high vacuum process capability
- Up to 8 process gas lines with digital MFC
- PC control with Ethernet communication

Reactor design



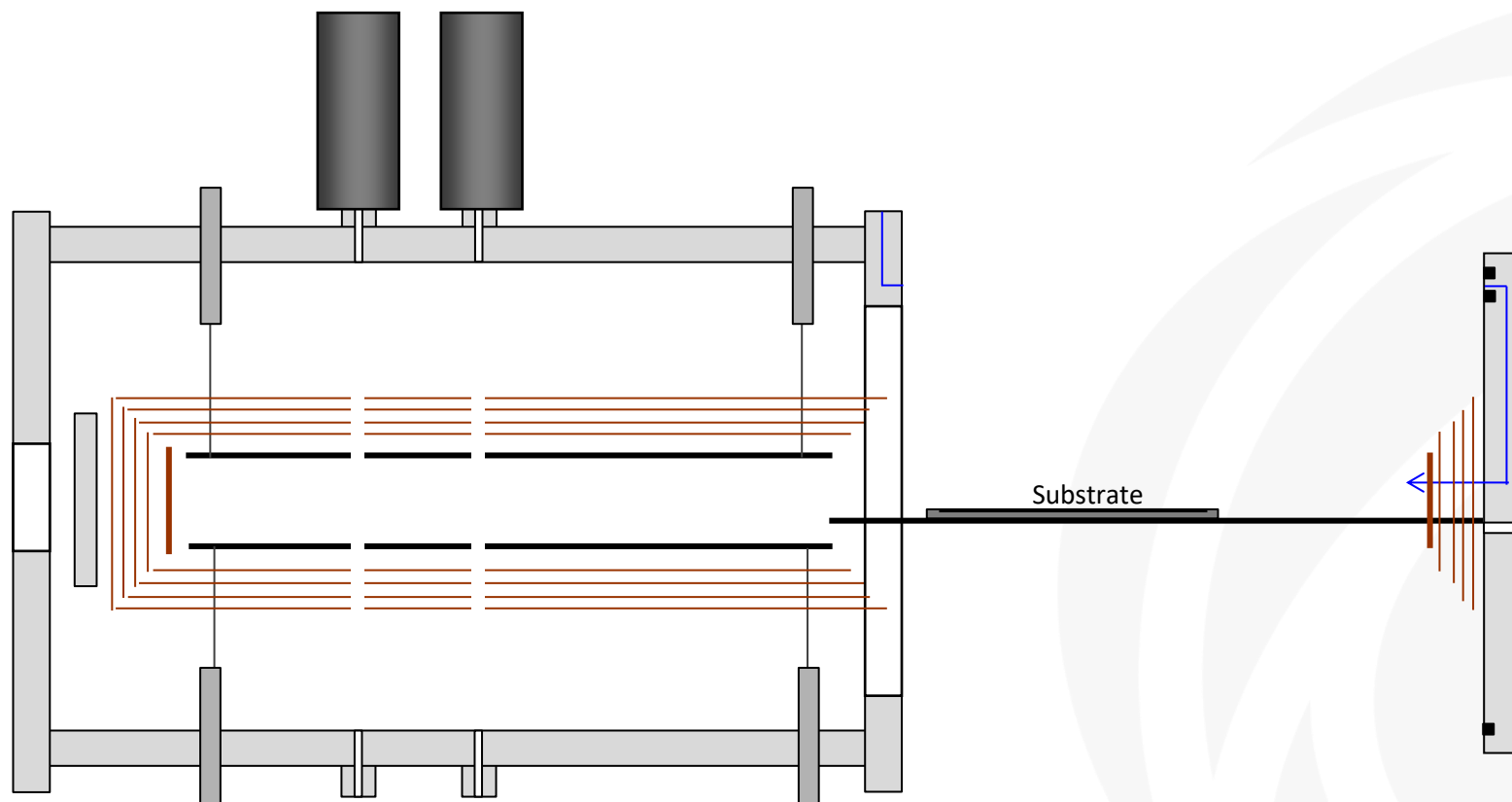
**Process gases are injected through the loading door.
They are pumped down through the flange on the opposite side**

Reactor design



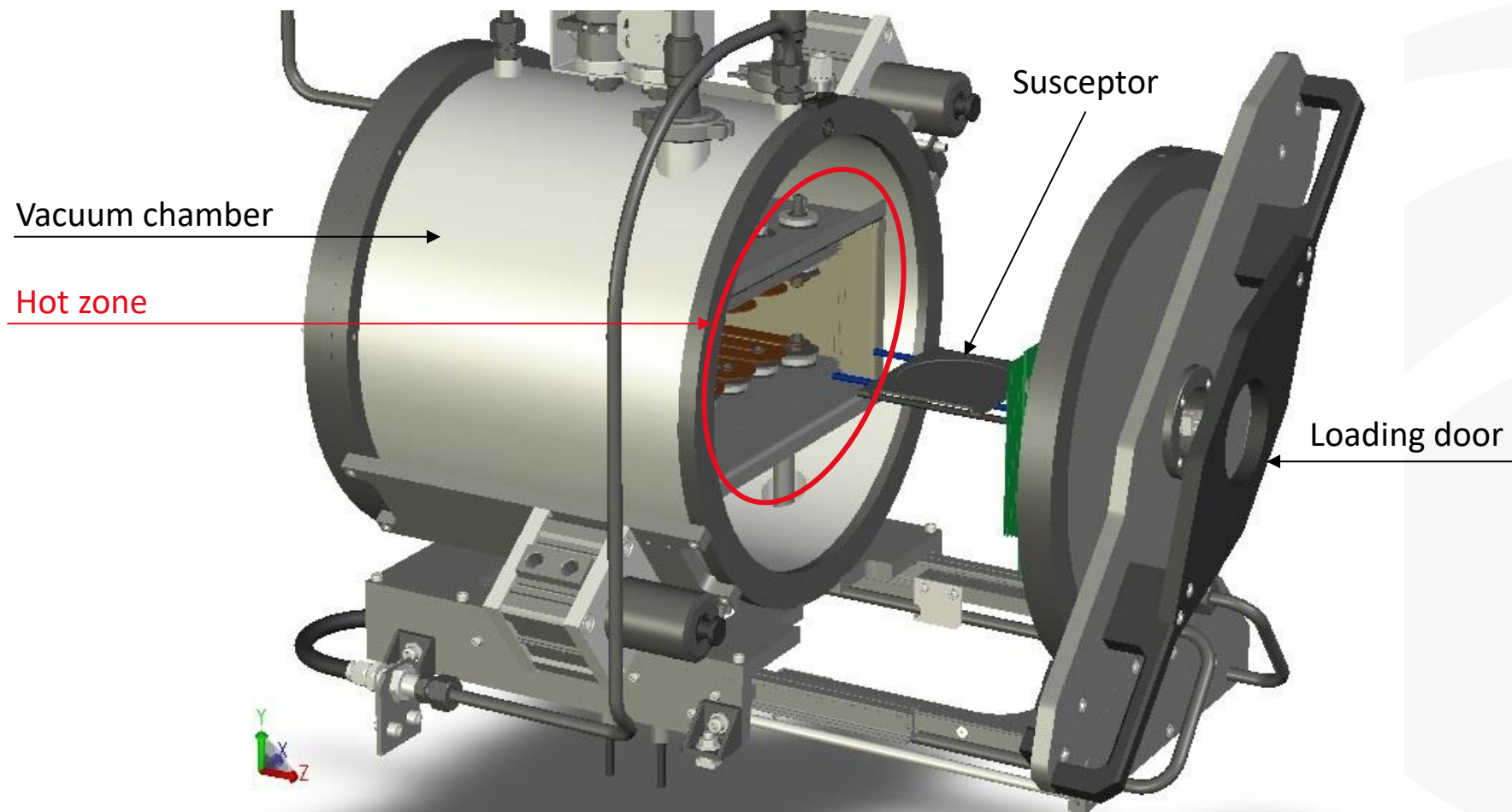
Chamber closed: process position

Reactor design



Chamber open: loading position

Reactor design



Hot zone design



Thermal shields

Heaters (top and bottom)

Temperature control

Pyrometer temperature control:

- ❖ Temperature range 450°C to 2000°C
- ❖ Central or edge position

Pyrometer calibration:

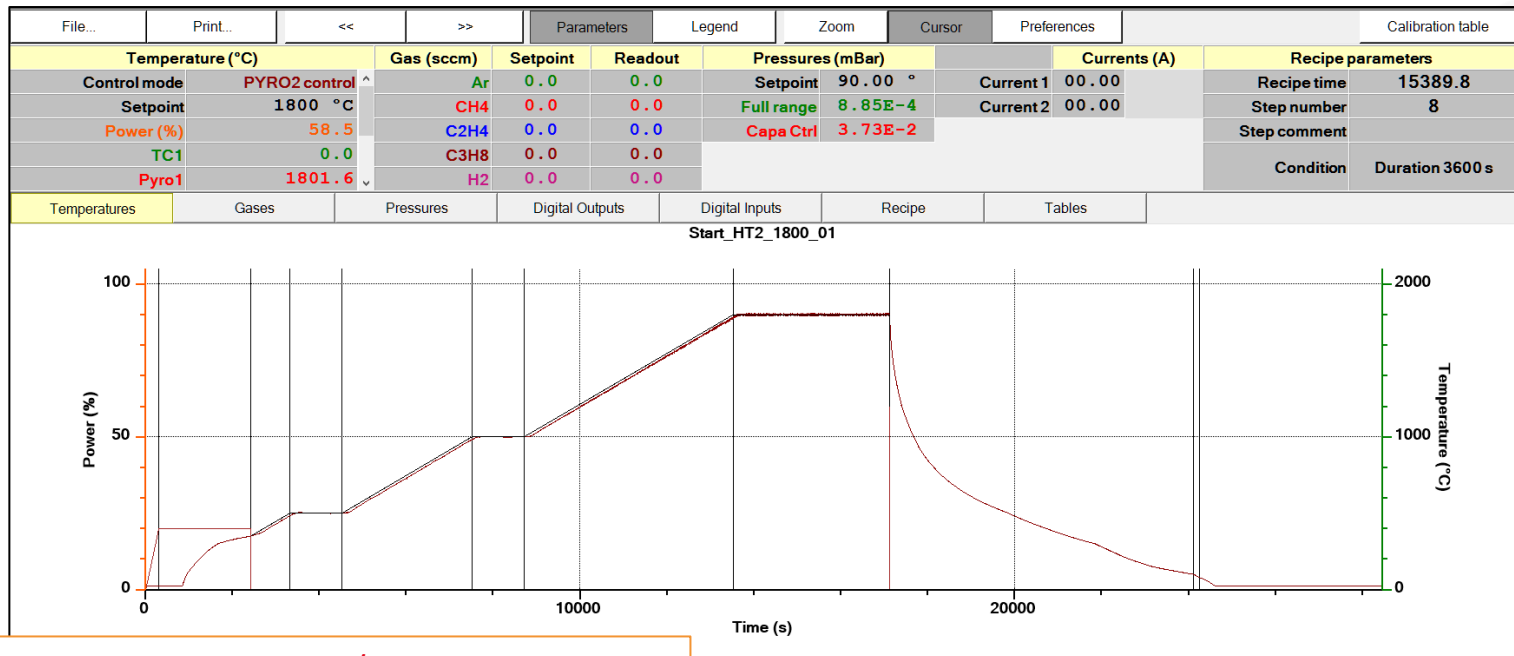
- ❖ By S type thermocouple (Room temperature to 1100°C)
- ❖ By melting points of 2 elements : Si and Ti* for high temperature
- ❖ Melting points provide data at 1414°C and 1668°C*

Fast digital temperature controller:

- ❖ Overshoot-less capability
- ❖ Set PID parameters for different temperature levels
- ❖ Automatic autotuning procedure
- ❖ PID parameter table associated to each recipe

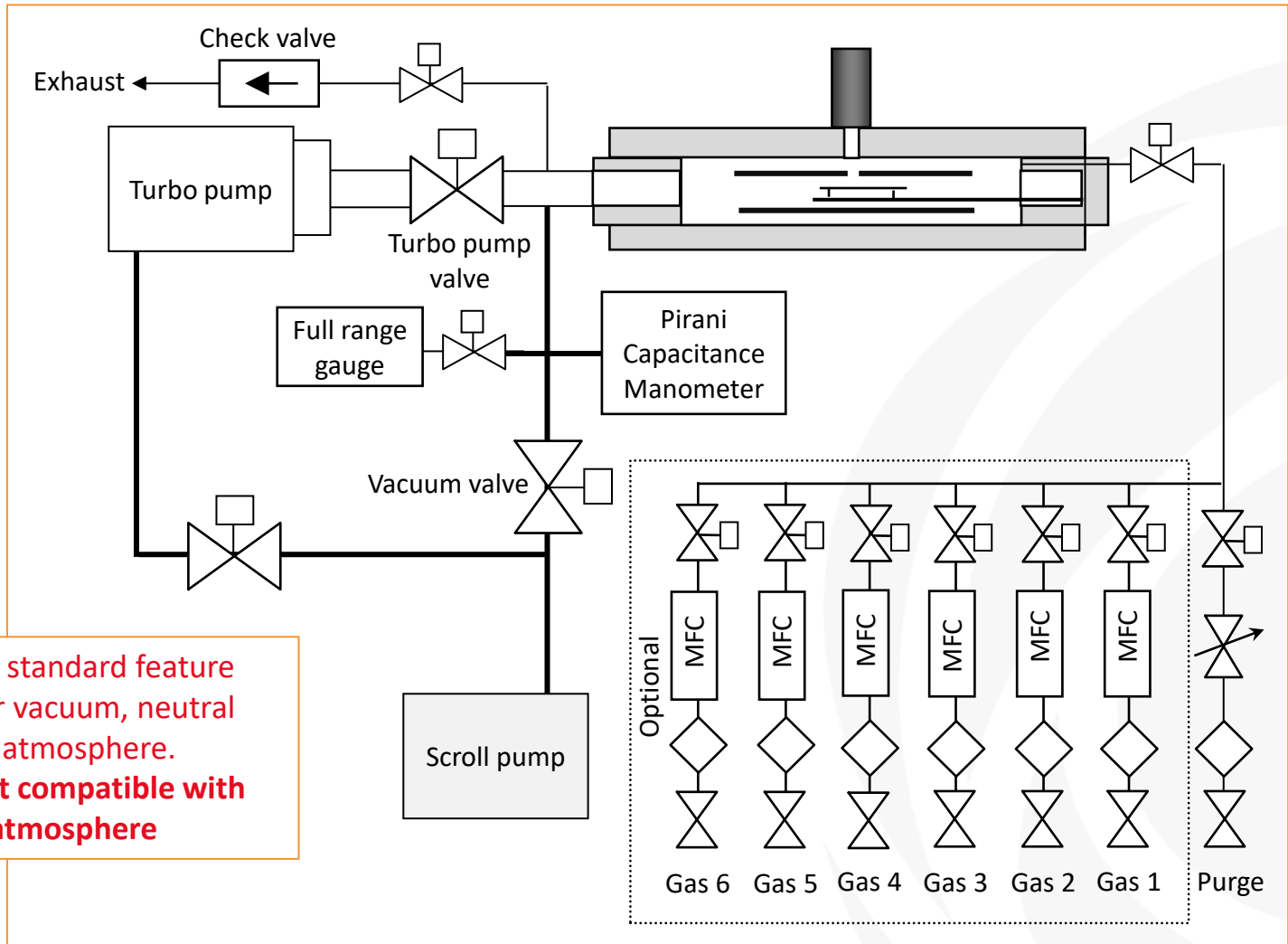
() H_2 gas line and downstream pressure control are required for the calibration by titanium melting*

Temperature control



Maximum ramp rate 4°C/s up to 1800°C
 Maximum temperature 2000°C
 Ambient temperature to 2000°C : 10 minutes
The system is not compatible with oxidizing atmosphere

Standard Vacuum and Gas configuration



Turbo pump is a standard feature
Annealing under vacuum, neutral
or reducing atmosphere.
**The system is not compatible with
oxidizing atmosphere**

Optional features

Warranty:	Warranty extension for second year Warranty extension for second and third year
System:	Additional process gas line Soft-pump angle valve to prevent samples from moving at initial pump down Capacitance manometer and downstream pressure control
Substrate holders:	Susceptor kit in graphite or SiC coated graphite
Vacuum:	Soft pump angle valve Dry scroll pump Turbo pumps
Safety features:	Nitrogen gas ballast Signal tower
Software:	Wafer traceability
Miscellaneous:	Spare part kits Side table for computer

PC Control Software

Same software for all Annealsys systems = robustness and reliability

Access modes:

Operator, Engineer, Administrator

Recipe mode:

Up to 400 operations per recipe

Capability to integrate macros into recipes

Process:

Full data logging

All data and tables saved in process historical file

Manual mode:

Manual control of heating, vacuum and gas

Configuration mode:

Mass flow ranges, calibration tables, alarm values...

Diagnostic mode

Easy troubleshooting

Automatic diagnostic report generation for remote support

PC Control Software: operation editor for process recipes

6852_Burnout_1800				Operation editor	Header
N°	Operation type	Operation details	Comment		
1	Condition	Waiting for Duration is = 5 s	Wait		
2	Macro	Macro_PrimaryPumping_SoftStart	Start primary pumping		
3	Condition	Waiting for Duration is = 600 s	Pumping		
4	RTP Temp	POWER control to 20 % with ramp at 0.1 %/s	Pre-heating 20%		
5	RTP Temp	POWER control to 20 % and waiting for Pyro 1 is > 400 °C	Wait for pyro>400		
6	RTP Temp	Pyro 1 control to 800 °C with ramp at 0.25 °C/s	Ramp to 800		
7	Condition	Waiting for Duration is = 600 s	Dwell at 800		
8	RTP Temp	Pyro 1 control to 1300 °C with ramp at 0.25 °C/s	Ramp to 1300		
9	Condition	Waiting for Duration is = 1200 s	Dwell at 1300		
10	RTP Temp	Pyro 1 control to 1800 °C with ramp at 0.16 °C/s	Ramp to 1600		
11	RTP Temp	Pyro 1 control to 1800 °C during 7200 s	Dwell at 1600		
12	RTP Temp	Pyro 1 control to 1500 °C with ramp at 0.16 °C/s	Ramp down to 1600		
13	RTP Temp	POWER control to 0 % during 1 s	Stop heating		
14	Condition	Waiting for Pyro1 is < 500 °C	Cooling		
15	Pumping	Stop	Stop pumping		

< Commands >

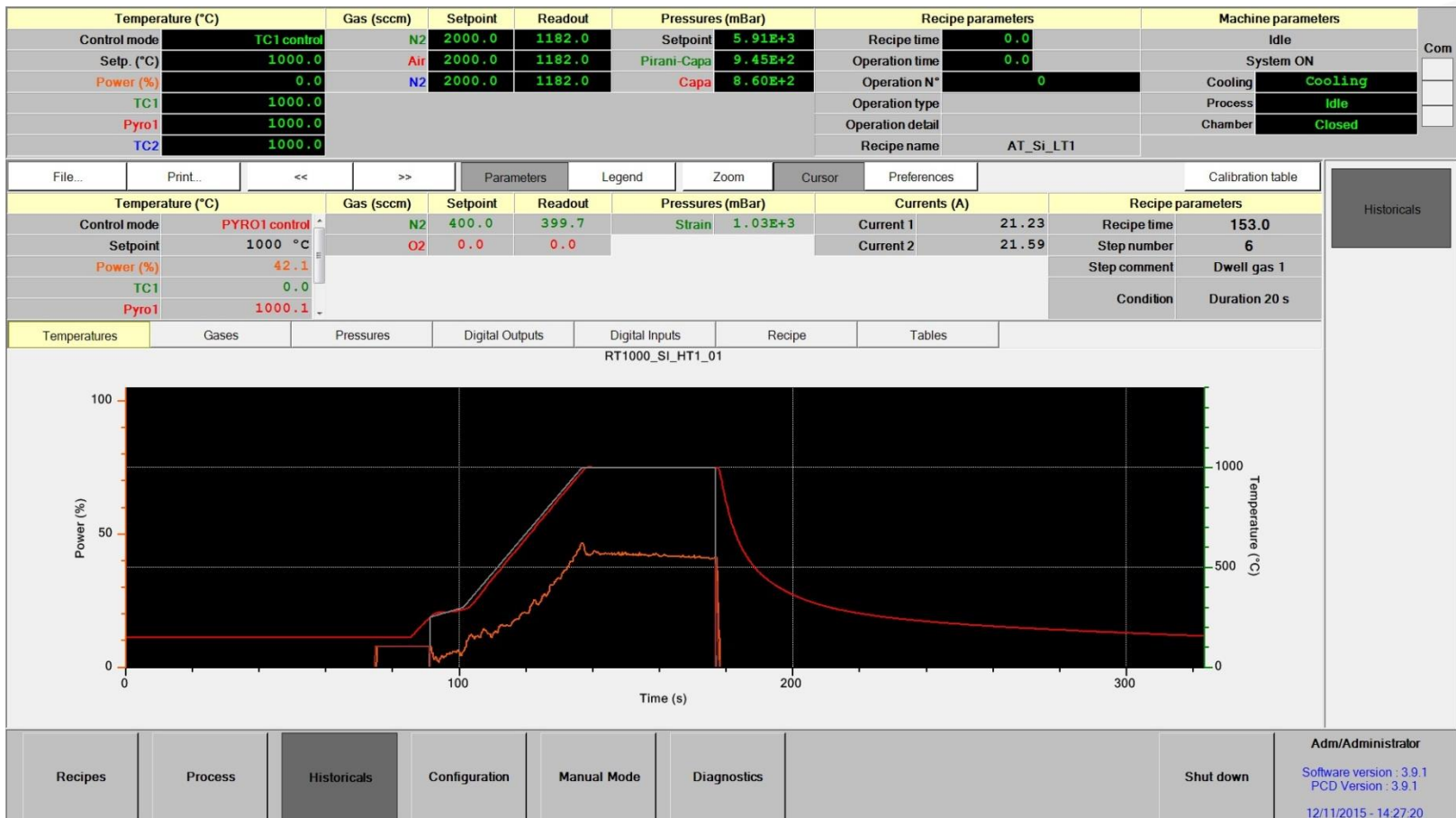
Add
Insert
Copy
Delete
Save
Print

Recipes
Process
Historicals
Configuration
Manual Mode
Diagnostics

Eng/Engineer
 Software version : 3.9.7
 PCD Version : 3.9.7
 10/07/2018 - 14:40:26

Operations

PC Control Software: Real time display and data collection



PC Control Software: Diagnostic capabilities

CVD Temperatures			Substrate holder		Gas / Pressures		Vaporizer		Liquid panel		Recipe parameters			Machine parameters		Com
Temperatures (°C)			Setpoint	Readout	Gas (sccm)	Setpoint	Readout	Pressures (mBar)		Recipe time	0.0	Idle				
Mixing chamber			800	378	N2	2000.0	356.0	Setpoint		1.18E+4	Operation time	0.0	System ON			
Sub. center			800	333	O2	5000.0	2358.0	CAPA_CTL		8.70E+2	Operation N°	0	Process	Idle		
Sub. edge			800	260	CF4	1000.0	354.0				Operation type		Chamber	Closed		
Reactor top			800	203	H2	200.0	136.0				Operation detail					
Reactor bottom			800	198	NH3	2000.0	356.0				Recipe name					
States			Inputs		Outputs		Miscellaneous		Alarms							
PCD configuration					Communication					Currents					Clear	
<div>----- 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</div>					<div>MFC 1No on going alarm MFC 2No on going alarm MFC 3No on going alarm MFC 4No on going alarm MFC 5No on going alarm MFC 6No on going alarm FUJI 1 readNo on going alarm FUJI 1 writeNo on going alarm FUJI 2 readNo on going alarm FUJI 2 writeNo on going alarm FUJI 3 readNo on going alarm FUJI 3 writeNo on going alarm FUJI 4 readNo on going alarm FUJI 4 writeNo on going alarm FUJI AI 1 readNo on going alarm FUJI AI 1 writeNo on going alarm Press. readNo on going alarm Press. writeNo on going alarm Source readNo on going alarm Source writeNo on going alarm SP 1 readNo on going alarm SP 1 writeNo on going alarm Rotation readNo on going alarm Rotation writeNo on going alarm</div>					<div>Age of substrate zone00:00:17Clear Power requested (%)0</div>						
Recipes		Process		Historicals		Configuration		Manual Mode		Diagnostics		Shut down		Adm/Administrator		
												Software version : 3.5.0 PCD Version : 3.5.0				

Make a diagnostic report

Specifications

	Zenith 150
Maximum substrate diameter	150 mm (6")
Maximum power	38 kW
Temperature range	450°C to 2000°C
Ramp rate	Maximum 4°C/s up to 1800°C Maximum 2°C/s up to 2000°C
Temperature control	Fast digital PID controller
Thermocouple	2 S type (RT to 1100°C)
Pyrometer temperature range	450°C to 2000°C
Pyrometer ports	2 (center and edge)
Gas injection	Loading door
Purge gas line	Standard
Process gas line with mass flow cont.	Up to 8
Vacuum valve and vacuum gauge	Standard

Facility requirements

	Zenith 150
Voltage	3x400V+N or 3x220V
Power	38 kW
Water flow	12 l/mn (3.2 GPM)
Compressed air	6 bars / 0.1 m ³ /h (90 PSI / 0.06 CFM)
Process gases	2 bars (30 PSI)

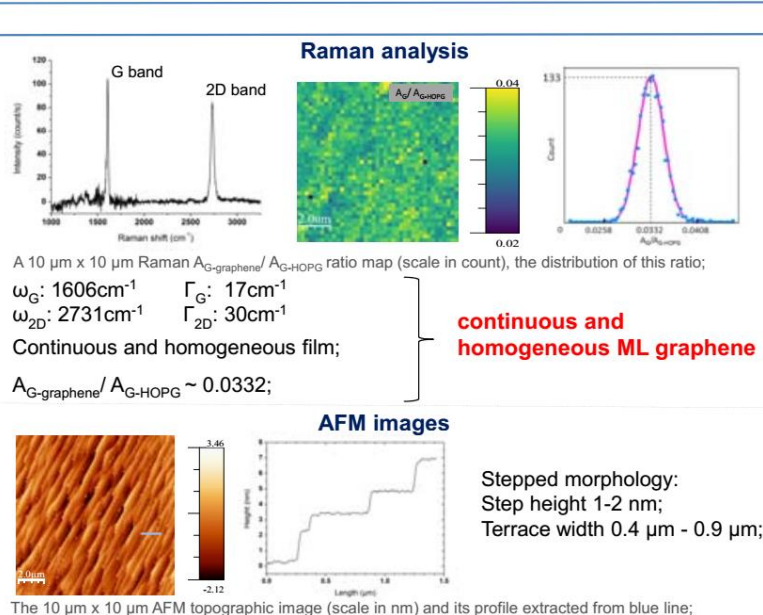
Dimensions and Weight

	Zenith 150
Width	800 mm (31.5 inches)
Height	2000 mm (78.75 inches)
Depth	1750 mm (68.9 inches)
Weight	500 kg (1100 pounds)

Process results

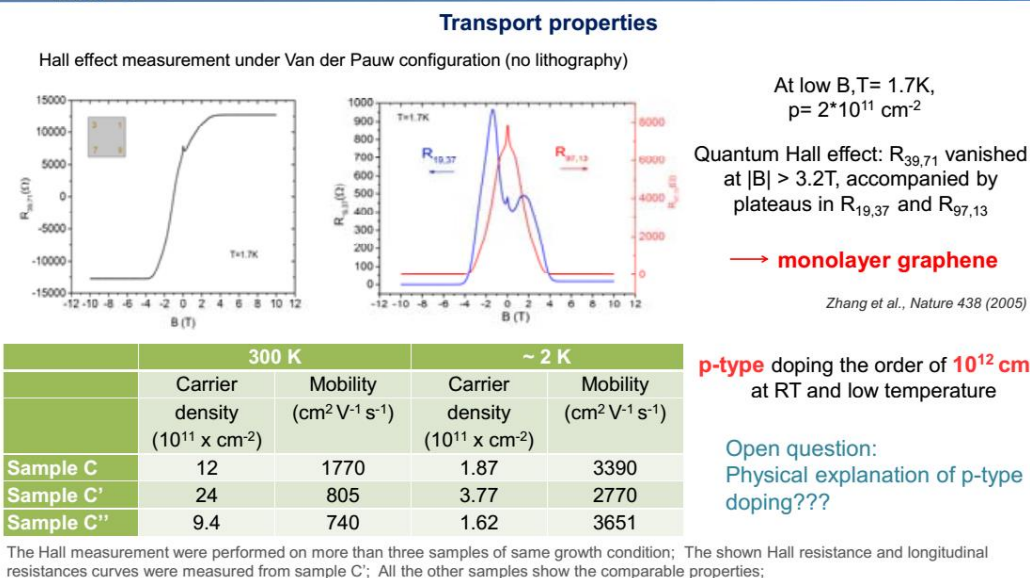
Growth of p-type monolayer graphene on SiC (0001) via sublimation at low argon pressure

T. Wang¹, P. Landois¹, M. Bayle¹, A. Nachawaty¹, W. Desrat¹, J.-R. Huntzinger¹, M. Paillet¹, J.-M. Decams², B. Jouault¹, S. Contreras¹
¹ Laboratoire Charles Coulomb (L2C), UMR 5221 CNRS - Université de Montpellier, Place Eugène Bataillon, 34095 Montpellier Cedex
² Annealsys, 139 rue des Walkyries, 34000 Montpellier, FRANCE



continuous and homogeneous ML graphene

1750°C



See related poster and publication for full information.

Thank you for your attention



139 rue des Walkyries
34000 MONTPELLIER
FRANCE

Tel: +33 (0) 467 20 23 63
Email: sales@annealsys.com

www.annealsys.com



L'Europe s'engage avec le
fonds européen de
développement régional
(FEDER)

