

Zenith-Series



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

3 sizes of systems:

Zenith-100

Zenith-150

Zenith-200

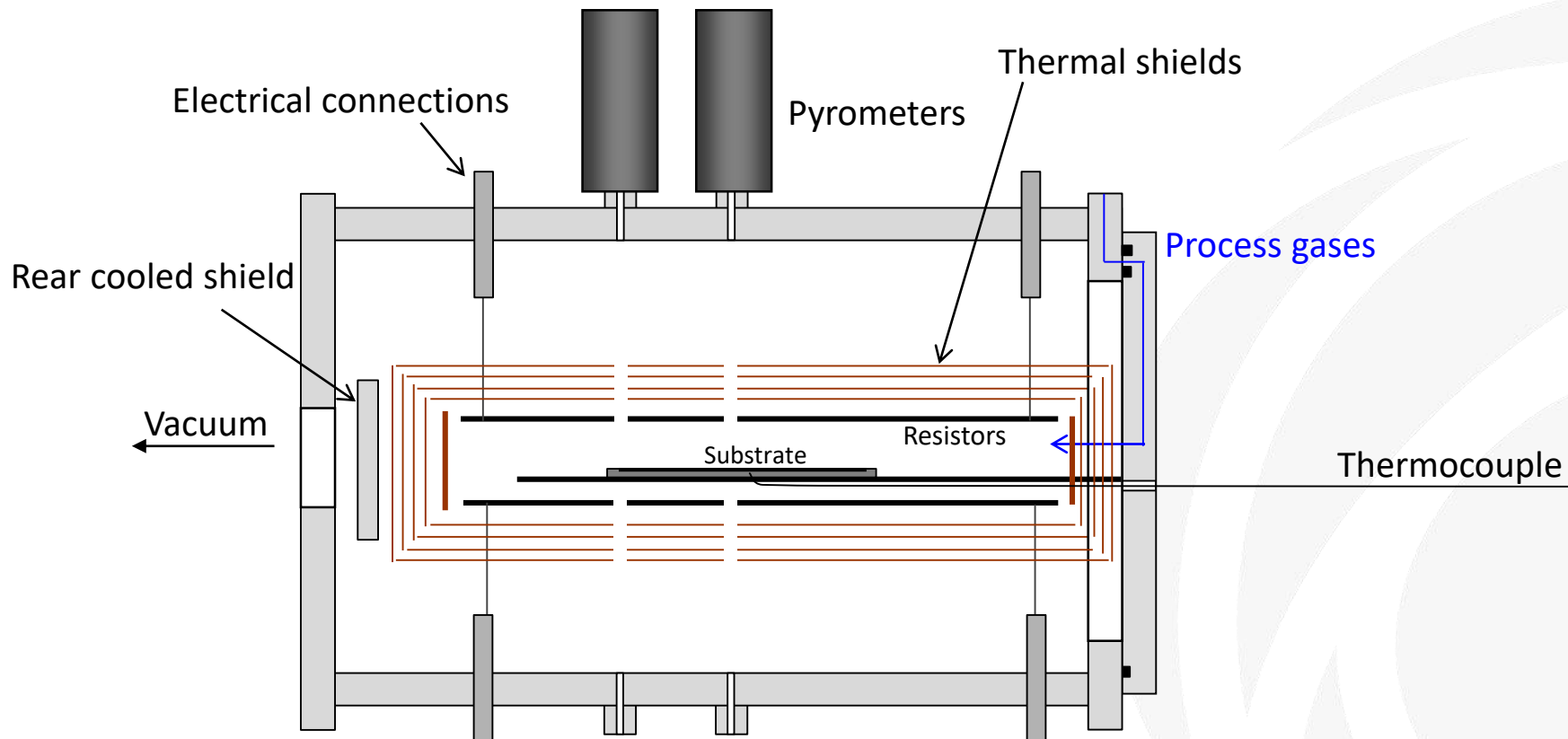
Applications

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

Key Features

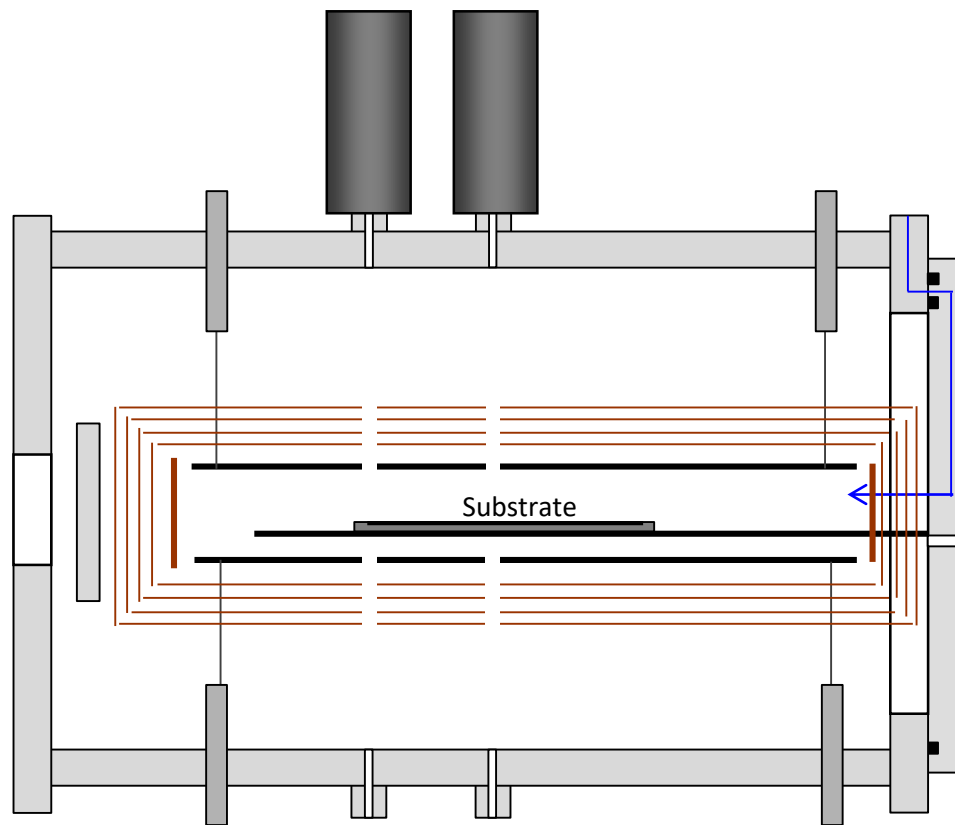
- Tungsten heater furnace
- Stainless steel cold wall chamber
- Easy substrate loading
- Fast digital PID temperature controller
- Pyrometer temperature control
- Atmospheric and high vacuum process capability
- Up to 8 process gas lines with digital MFC
- PC control with Ethernet communication

Reactor design



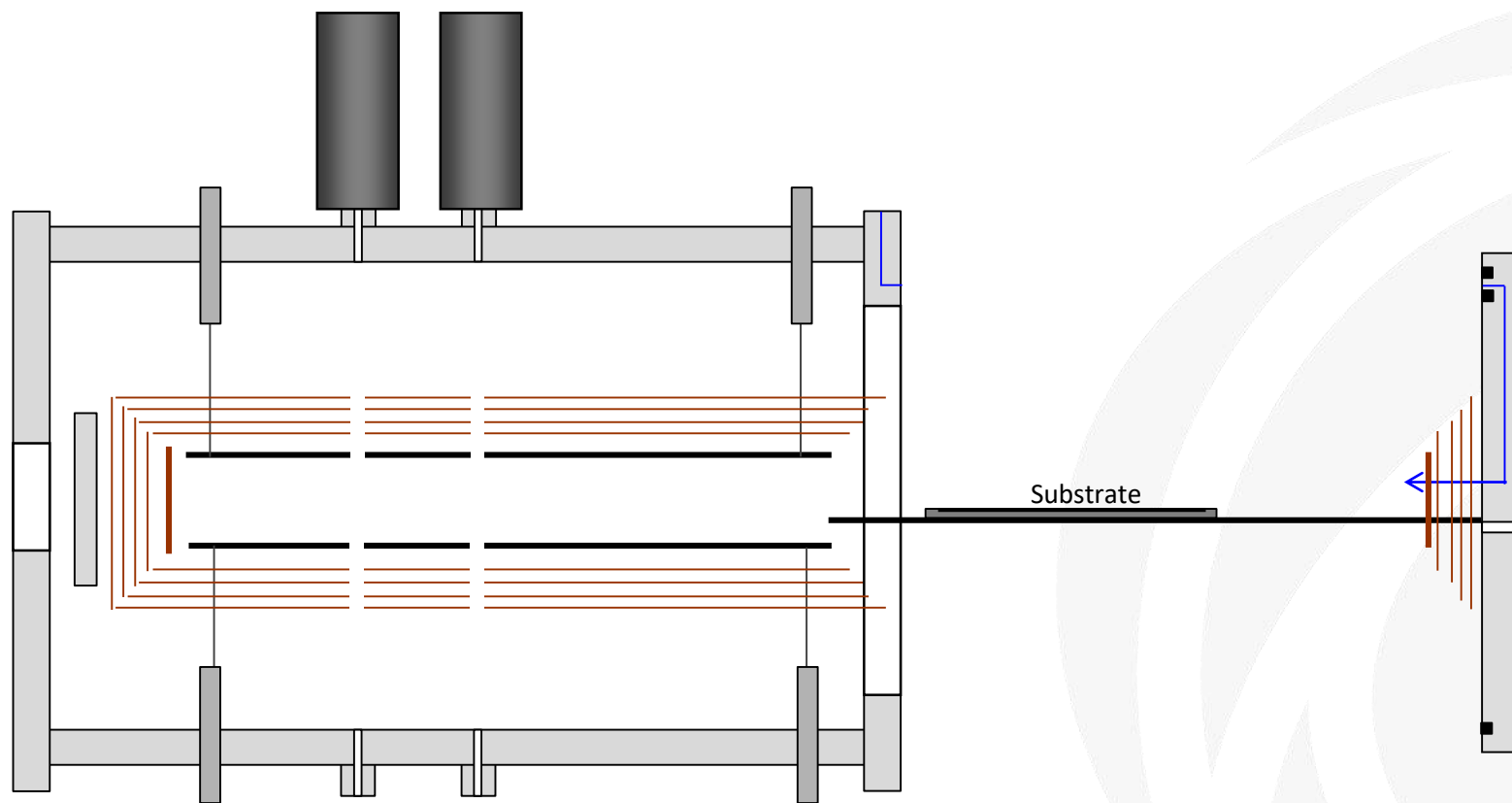
**Process gases are injected through the loading door.
They are pumped down through the flange on the opposite side**

Reactor design



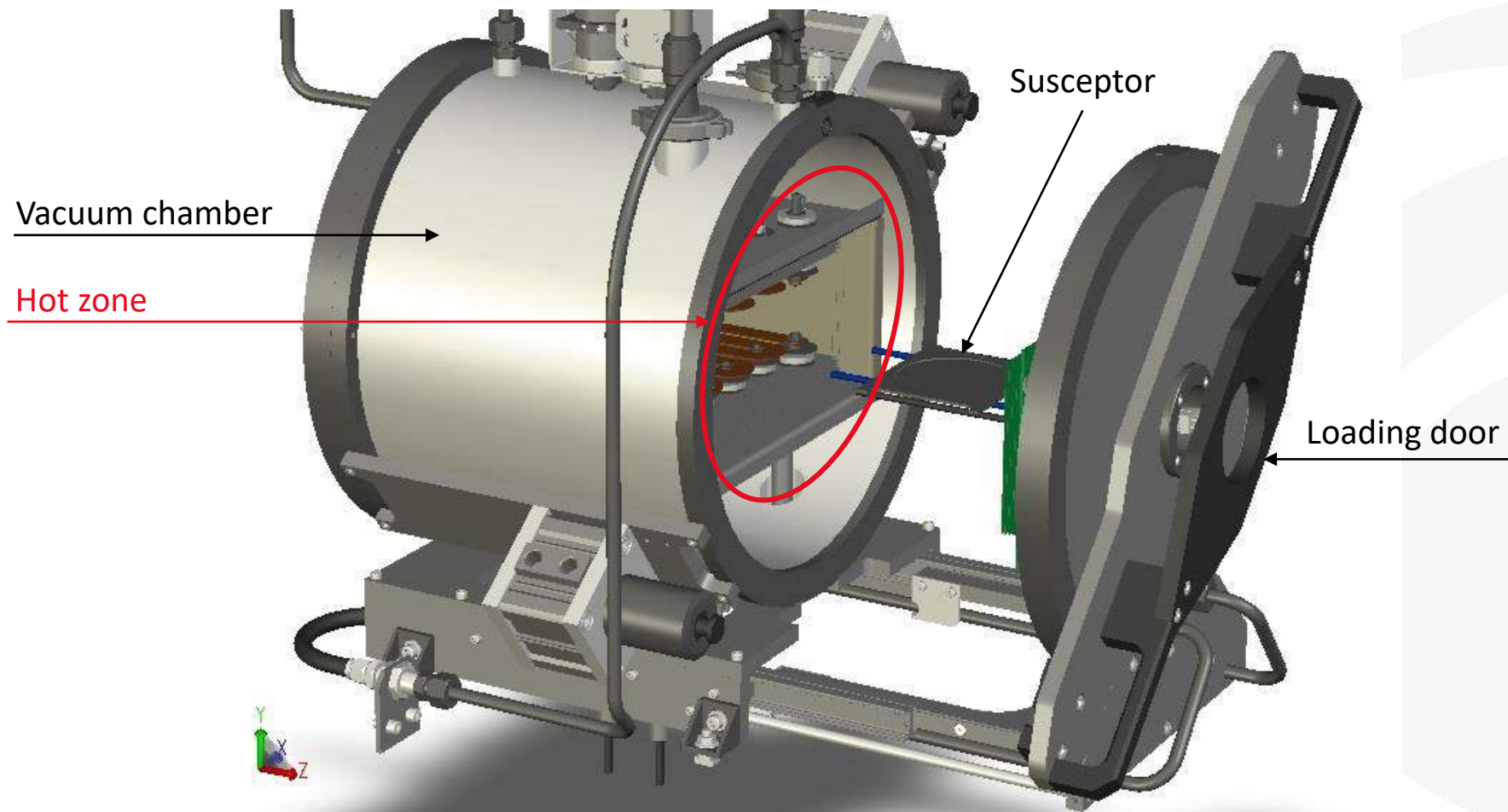
Chamber closed: process position

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:

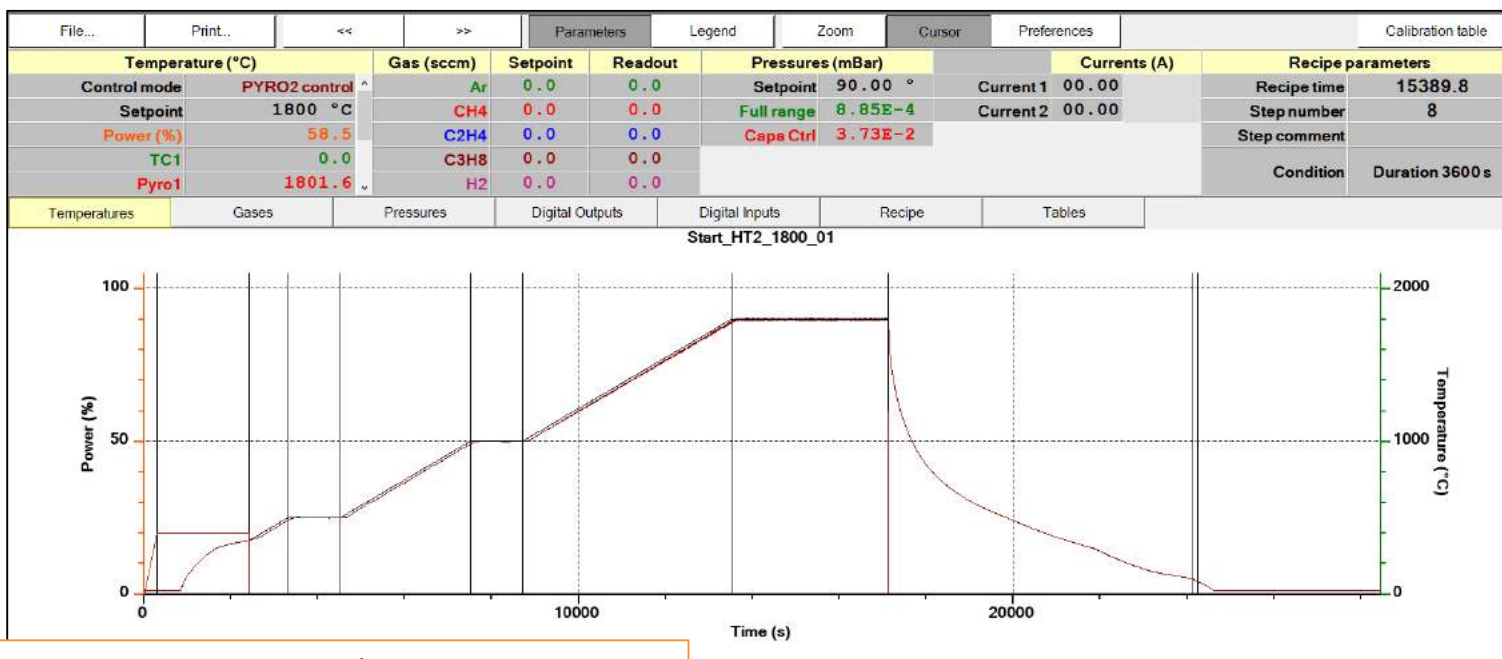
- ❖ By S type thermocouple (Room temperature to 1100°C)
- ❖ By melting points of 2 elements : Si and Ti* for high temperature
- ❖ Melting points provide data at 1414°C and 1668°C*

Fast digital temperature controller:

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

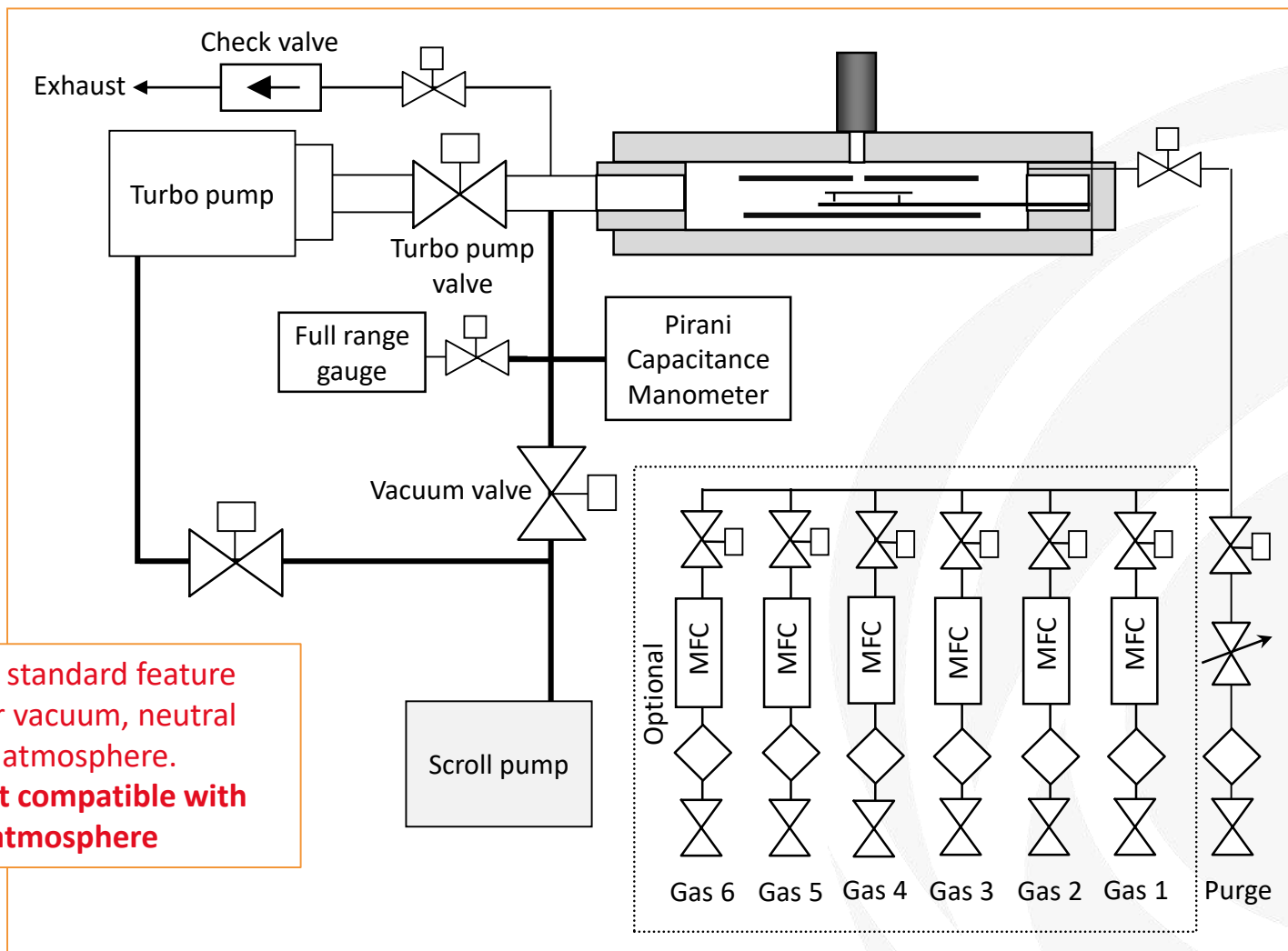
() H₂ gas line and downstream pressure control are required for the calibration by titanium melting*

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 levels:

Operator, Engineer, Administrator

Recipe mode:

Up to 400 operations per recipe

Capability to integrate macros into recipes

Capability to do loops into the recipe

Process:

Full data logging

All data, recipe and tables saved in process historical

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

Shut down

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		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				Clear			
PCD configuration				Communication				Currents							
<div>-----</div> <div>System ID : MC200 STANDARD - 5853</div> <div>Wiring : 103</div> <div>Main PCD version : 3.2.0</div> <div>Main PCD firmware : D3M531160</div> <div>Number of zones : 0</div> <div>Number of currents: 0</div> <div>RTP Tmp controller: WITHOUT</div> <div>Number of zonesCVD: 16</div> <div>CVD Tmp controller: FUJI</div> <div>Remote oven : No</div> <div>RKC Direct : No</div> <div>SensorBoard : No</div> <div>SensorBoard 2 : No</div> <div>OPT_PYRO1 : No</div> <div>OPT_PYRO2 : No</div> <div>OPT_4_20mA : No</div> <div>Double furnace : No</div> <div>Number of chambers: 1</div> <div>Power Ratio : False</div> <div>Number of MFM : 0</div> <div>Number of MFC : 6</div> <div>MFC Type : REMOTE_LQP1</div> <div>Gas in Group1 : 0</div> <div>Gas in Group2 : 0</div> <div>Vaporizer 1 : KS_VAPORIZER1</div> <div>Vaporizer 1 mode : MODE_1</div> <div>Vaporizer 1 vers. : 0.</div> <div>Vaporizer 2 : KS_VAPORIZER1</div>				MFC 1	No on going alarm	Age of substrate zone	00:00:17	Clear	Clear						
				MFC 2	No on going alarm	Power requested (%)	0								
				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														

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

Adm/Administrator

Software version : 3.5.0
PCD Version : 3.5.0

Specifications

	Zenith 100	Zenith 150	Zenith 200
Maximum substrate diameter	100 mm (4")	150 mm (6")	200 mm (8")
Maximum power	38 kW	44 kW	70 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 100	Zenith 150	Zenith 200
Voltage	3x400V+N or 3x220V	3x400V+N or 3x220V	3x400V+N or 3x220V
Power	38 kW	44 kW	70 kW
Water flow	12 l/mn (3.2 GPM)	14 l/mn (3.7 GPM)	30 l/mn (7.9 GPM)
Compressed air	6 bars / 0.1 m ³ /h (90 PSI / 0.06 CFM)	6 bars / 0.1 m ³ /h (90 PSI / 0.06 CFM)	6 bars / 0.1 m ³ /h (90 PSI / 0.06 CFM)
Process gases	1 bar (14.5 PSI)	1 bar (14.5 PSI)	1 bar (14.5 PSI)

Dimensions and Weight

	Zenith 100	Zenith 150	Zenith 200
Width	800 mm (31.5 inches)	800 mm (31.5 inches)	1100 mm (43.3 inches)
Height	2000 mm (78.75 inches)	2000 mm (78.75 inches)	2000 mm (78.75 inches)
Depth	1750 mm (68.9 inches)	1750 mm (68.9 inches)	2000 mm (78.75 inches)
Weight	700 kg (1543 pounds)	750 kg (1653 pounds)	950 kg (2094 pounds)

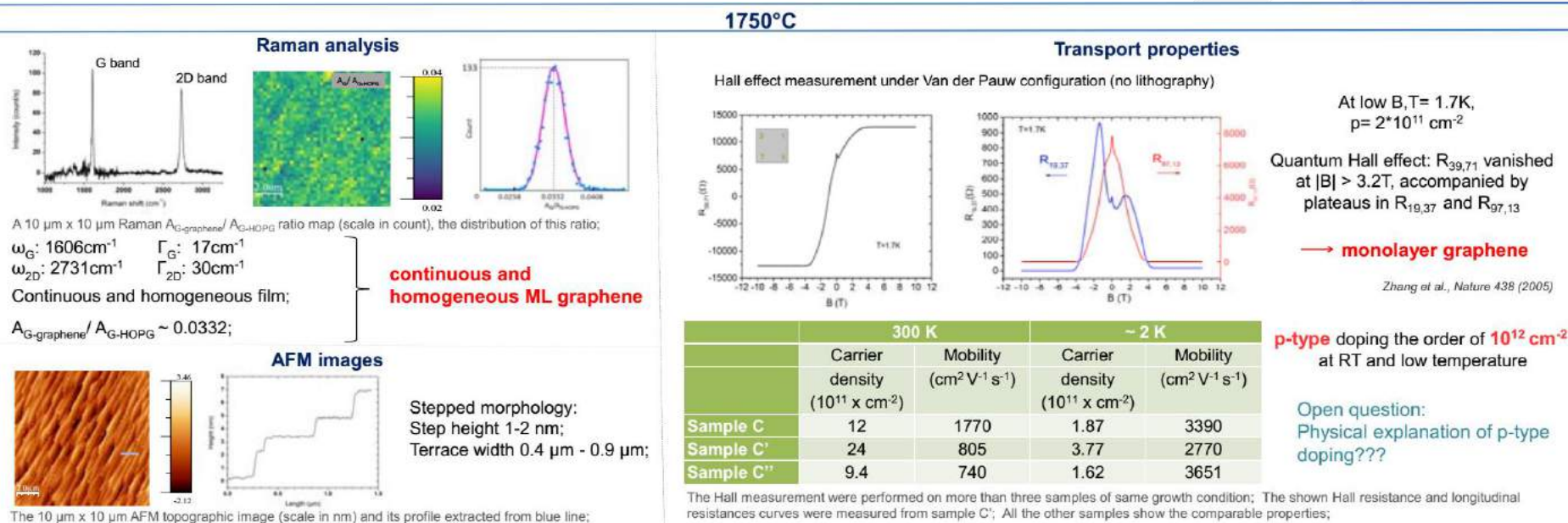
Zenith customers

France:	University of Montpellier ISL
China:	Institute of Semiconductors - CAS
Italy:	Institute for Microelectronics and Microsystems
Poland:	IET - Instytut Technologii Elektronowej
United Kingdom:	Swansea University
United States:	Argonne National Laboratory

Process results

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

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See related poster and publication for full information.

Thank you for your attention



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fonds européen de
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(FEDER)

