

Horizontal Firing & Dryer Furnace System

HF series

Introduction

System Picture



Process

- 1) Application : Removal of Solvent & Volatiles & Resin Dissolution of SiN:H Contact formation through fusing and alloying
- 2) Wafer size : Max. 156mm X 156mm
- 3) Wafer moving speed : > 760 cm/min
- 4) Loading capacity : 50 wafers/tube (include dummy)

Configuration

- In-line belt type firing & dryer system
- Substrate size : Max. 156mm X 156mm
- Wafer moving speed : > 760 cm/min
- Firing depth : 5um
- Production rate : over 2,500 wafers/hr
- Three(3) zone control for dry process optimization with IR lamp. (Max.1000 °C)
- Six(6) zone control for dry process optimization with IR lamp.
- Temperature repeatability : < ±2°C
- Load/unload : Mesh type weave belt (Manual)
- PC control

Process chamber module – Dryer Module

- IR lamp Heater
 - IR lamp heater temperature is maximum 500 ℃ at heater surface.
 - Three(3) zone temperature control
 - Spike / profile thermocouples for reading temperature.
 - Alarm systems for excess temperature, SCR overheat and chamber overheat.
 - Venturi assisted exhaust stack draws heated gases from the dryer and firing sections
 - A small open containment area is embedded in the top & bottom layers of the porous ceramic muffle
 - Each zone has a separate CDA flow meter & piping for flows to belt (particularly for dilution & removal of VOC & other contaminants)
 - The construction of the transition tunnel is similar to the entrance and exit baffles.
 - The entrance & exit baffle are included drop down design for quick & easy accessibility.
 - Long open inspection area is provided between the dryer and furnace sections.
 - The radiant cooling section is constructed of formed and welded aluminum
 - Cooling water are machined into the top & bottom cold walls for rapidly cooling
 - A gas curtain of air is generated by introducing distributed gasses.
 - The lower half cooling module is drop down design for quick &easy



< IR lamp heater module >



< IR lamp heater module >



< Dryer module >

Process chamber module – Firing module

- IR lamp Heater
 - IR lamp heater temperature is maximum 1,000 ℃ at heater surface.
 - Six(6) zone temperature control
 - Spike / profile thermocouples for reading temperature.
 - Alarm systems for excess temperature, SCR overheat and chamber overheat.
 - Venturi assisted exhaust stack draws heated gases from the dryer and firing sections
 - A small open containment area is embedded in the top & bottom layers of the porous ceramic muffle
 - Each zone has a separate CDA flow meter & piping for flows to belt (particularly for dilution & removal of VOC & other contaminants)
 - The construction of the transition tunnel is similar to the entrance and exit baffles.
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< IR lamp heater module >



< IR lamp heater module >



< Firing module >



Load/unload module

- Load/unload module
 - Mesh type balance spiral open weave belt (material : Nichrome V)
 - Standoff belt type for Decreased wafer exit temperatures/ improved cooling
 - Wafer moving speed : > 760 cm/min
 - Production rate : over 2,500 wafers/hr
 - Speed control : Closed loop type , accuracy \pm 0.5% over the full belt speed range.
 - Belt operation by AC motor for stable movement
 - Friction drive with rubber coated drive rollers.
 - Solid quartz rods with belt for minimize belt wear and shadowing affect of the wafers
 - High dilution purge of the process chamber



< Load/unload module >



< Standoff belt >



< AC motor >

Cooling module

- Cooling module
 - The radiant cooling section is constructed of formed and welded aluminum
 - Cooling water are machined into the top &bottom cold walls for rapidly cooling
 - A gas curtain of air is generated by introducing distributed gasses.
 - The lower half cooling module is drop down design for quick &easy
 - The water cooling system will include the following
 - : A manual shut off valve at the inlet location.
 - : A pressure regulator control valve with gauge for setting the inlet water pressure
 - : A manifold for distributing the water to the different cooling circuits.
 - : A flow meter to control the flow of each cooling circuit.
 - : Temperature indication at the input and output at the cooling water system.
 - The short open area between the radiant cooling and convective cooling section serves as a pressure relief to
 prevent post forced cooling air from entering the water cooling and heating chamber.
 - A blower driven downward uniform flow over the entire surface area of the convective cooling section.
 (This flow is then collected and exhausted from below the belt.)

Control Module

- System control
 - System is controlled automatically by PC
 - Industrial PC (PENTIUM, 17" LCD monitor)
 - Including analog & digital input/output card
 - User friendly screen & easy graphic user interface (GUI)

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
P	10	10		.0	5	5
I	40	38	47	41	80	87
D	0	0	0	0	0	0
Teap SV	560	560	560	560	850	500
	560	560	560	560	850	.900
SCR Output	37	35	34	31	.49,	53
Reptor (B	06	0	(a)	- 28	- 06	- On
Fon 4	1 Fan #2	Fon #3 Fon 60 0 80 0				Bol 600 000 (.)

< Firing Control program GUI >



< Dryer Control program GUI >

Frame Module

- System frame is mild steel
- White & Blue colored panels & frame covers
- 19inch control panel mountable
- Easily movable casters & leveling foots



Warranty

Manufacturer warrants for a period of one(1) year from the final acceptance.

This warranty shall become null and void upon any modification and/or improper service performed to the equipment by the customer. This warranty shall not be extended to those defects caused by improper operation, maintenance and handling by the customer.

All consumable, such as O-rings, view port glasses, fuses, firing board, down transformer and others, are entirely excluded from warranty.

Solar cell efficiency measure

• Solar cell efficiency measure

	Efficiency measurement results						Average
	Voc(V)	Isc(A)	<u>FF</u> (%)	Eff(%)	$\underline{Rs}(\Omega)$	$\underline{Rsh}(\Omega)$	efficiency
Sample #1	0.620	8.707	78.92	17.82	0.006	11.251	- 17.75 %
Sample #2	0.619	8.722	77.84	17.60	0.006	3.802	
Sample #3	0.625	8.855	77.99	18.08	0.006	7.262	
Sample #4	0.619	8.716	79.06	17.87	0.006	9.732	
Sample #5	0.619	8.720	78.18	17.67	0.006	3.491	
Sample #6	0.619	8.694	78.22	17.63	0.006	3.829	
Sample #7	0.622	8.767	77.21	17.64	0.006	2.555	
Sample #8	0.616	8.675	78.91	17.67	0.006	60.076	



< Solar cell efficiency measure , I-V curve >

Temp profile test (Dryer)

• Heat & cool time graph



Temp profile test (Firing)

• Heat & cool time graph (9 times test results)



SIMS depth profile (firing)

• BSF SEM



BSF depth test

• 6inch Si solar cell Al BSF SEM



ULTECH Co., Ltd.

SIMS depth profile (firing)

• Ag SIMS



SIMS depth profile (firing)

• BSF SEM



Temperature flow analysis (Dryer)

• Simulation

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Temp.	300℃	250℃	240°C	210°C	210℃





< Analysis results >

Rapid cooling system analysis (Firing)

• Simulation



< Analysis model >

