

Run-to-run thickness uniformity often is at issue for epitaxial reactors. Since it is primarily affected by the way silicon is controlled and distributed, usually it does not greatly depend on reactor design. However, especially for single-wafer reactors, run-to-run thickness uniformity makes reactor performance much worse than expected. LPE has developed a tool to significantly improve this key factor. This patent tool, nicknamed Bubbler, has been widely tested on LPE reactors and on reactors of other makes, both batch and single-wafer type.



Liquid chlorosilane bubbler saturator



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SYSTEM DESCRIPTION

The Bubbler cylinder is filled with liquid Chlorosilane to about 70%, while the remaining space is the expansion space for overlying vapor.

During deposition, liquid level changes a few centimeters, so that carrier gas saturation and mixture ratio suffer negligible changes. Higher stability of liquid temperature is given by a large heat-exchange surface and by a water jacket. Usual water temperature ranges 18 to 25°C. Correct temperature values depend on specific process requirements. It is highly recommended to provide water with temperature variation < +/- 1°C. Therefore, for a given set-point, the relevant silicon amount delivered to reactor is extremely constant.

For further care, liquid Chlorosilane is not refilled during deposition or vent step, but is controlled by a purge valve of reactor (usually the hydrogen purge valve) through the Control Box, so as to prevent prejudicing saturation parameters during deposition.

All this ensures higher, time-tested process reliability.

CONTROL BOX

CONTROL BOX FOR AUTOMATIC REFILLING (*)

Two Control Box models are available: for single and dual-station reactors.

The Control Box is a separate controller which monitors the Chlorosilane level in the Bubbler and, through a signal from the reactor, performs Bubbler refilling. Bubbler refilling is not allowed during deposition or vent step prior to deposition.

Refill is made by pressurizing the main Chlorosilane tank at 0.5-1.5 bar pressure; the liquid is forced to the Bubbler through a pneumatic valve actuated by the liquid level sensor in the Bubbler, and by the Control Box, until level is restored.

A separate safety level sensor shuts off the pneumatic valve in the event of main sensor malfunctioning, and activates a sound alarm.

Also when failing to achieve refill level (main tank empty), a sound alarm will warn the operator.

() The Control Box is supplied only for application to reactors not manufactured by LPE. In LPE reactors, Bubbler functioning logic is integrated in the reactor software.*

APPLICATION NOTE

Two bubbler models are available: Standard and Minispeed.

- the Standard bubbler (14 liters capacity) has been designed for high growth speed (approx. 20 to 60 grams per minute of Chlorosilane with approx. 25 liters/minute of H2 carrier) and long deposit process.
- the Minispeed bubbler (4 liters capacity) better fits low and very low growth speed applications (approx. 2 to 15 grams per minute of Chlorosilane with approx. 8 liters/minute of H2 carrier) because of low dead vapor volume and fast stabilization.

Chlorosilane capacity at refill level (approx. values)

	std - TET	std - TCS	mini - TET	mini - TCS
liters	14.3	14.3	4.15	4.15
Kg	21	19	6	5.5

Liquid level variation

figures in mm/min.x gram of chlorosilane output				
	std - TET	std - TCS	mini - TET	mini - TCS
	0.0353	0.0387	0.1228	0.1346

Example

Process requires 28.0 grams/minute TET for 15 minutes (+ 1 minute pre-purge) - bubbler std. Model. Level decrease at the end of process will be. ==> 0.0353 x 28 x 16 = 15.8 mm

Please contact LPE to decide the best fit for your application.

CONSTRUCTION

Materials: AISI 316 electropolished for parts in contact with gases or liquid
Connections: VCR
Welding: Orbital

DIMENSION AND WEIGHT

	overall (mm)	inside (mm)	weight Kg (empty)
Std model	210x210x1230 h	dia 155x990h	34
Minispeed model	160x160x1230 h	dia 83x990h	16

Control Box

150 w x 230 l x 150 h mm , weight 2 Kg
Note: the Control Box can be located up to 15 meters away from bubbler

