

TECHNICAL NOTE

When Reproducibility Counts Multiple Sensor Measurement with the IC/5 Thin Film Deposition Controller

For special optical coatings and other deposition applications in which reproducibility is important, the multiple sensor measurement capability in the IC/5 Deposition Controller ensures consistent deposition rate and final thickness from one run to the next.

LIMITATIONS OF SINGLE-SENSOR CONTROL

Because a typical evaporative source has a cosine distribution, substrates are often mounted on a rotating planetary fixture for more even coating over larger areas. This approach is successful in achieving substrate-to-substrate uniformity within a run, but does not address run-to-run reproducibility.

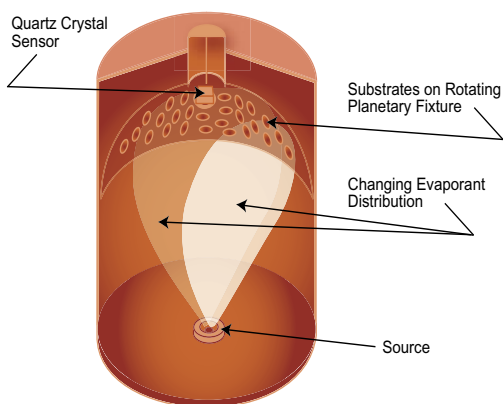
Since most quartz crystal deposition controllers use only one sensor, the information gathered—while accurate for that one point—reflects only the activity in that sensor's vicinity. This limited information does not adequately represent the source distribution variations throughout the coating area and throughout the duration of the run as the source depletes or

other changes occur. In effect, the single-sensor controller over or under compensates, and for some applications results in unacceptable rate and thickness control, accuracy and reproducibility.

LIMITATIONS OF MULTI-CONTROLLER CONTROL

In an attempt to obtain more representative data (and thus improve film quality and yield), some systems are equipped with multiple sensors, each linked via its own dedicated controller to a central computer. While this approach does provide more useful information than a single-sensor configuration, it, too, has drawbacks:

- The custom software to integrate multiple controllers requires significant programming time and special skills.
- The shared central computer slows response time.
- Multiple controller units require excessive cabling and significant rack space.



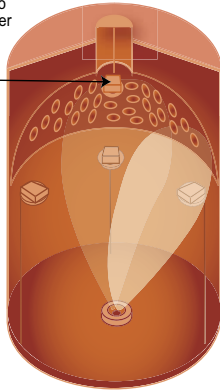
Single-Sensor Configuration

Single-sensor deposition controllers may initially achieve excellent rate control at the sensor location. However, when the source distribution changes the single-sensor is no longer adequate. As a result, for some applications thickness reproducibility will be inadequate, and rate control inconsistent. In the end, a single-sensor controller can produce unacceptable films and product yields.

ADVANTAGES OF THE IC/5 MULTIPLE SENSOR CONTROLLER

The INFICON IC/5 Deposition Controller can integrate rate and thickness information from up to eight quartz crystal sensors located around the planetary fixture. Each sensor's measurement is "weighted" and combined with the others to determine the system's effective rate, an aggregate rate for source control.

Up to 8 Quartz Crystal Sensors Linked to one IC/5 Controller (4 shown)



IC/5 Multiple Sensor Configuration — The IC/5 controller collects data simultaneously from various locations within the chamber, ensuring information that is representative of current source distribution. This enhanced information significantly improves control and, therefore, thickness reproducibility.

As source distribution patterns change, the IC/5 adjusts the power appropriately. Although the rate at any one sensor may vary significantly, the total amount of material deposited on each substrate in the rotating planetary is controlled and accurate; overall thickness can be within 0.5% of the desired amount.

ACCURATE MONITORING

The INFICON IC/5 detects shifting source characteristics from the relative deposition rates measured at each sensor. Accurately tracking these changes as the source depletes allows the user to:

- anticipate when to replenish the source,
- determine the optimum settings for the e-gun sweep, amplitude, and dither, and
- formulate better process recipes.

CONSISTENT THICKNESS

Each substrate is exposed to the aggregate deposition rate. Since the IC/5 calculates this aggregate rate quickly and provides tight control of this rate, layer-to-layer and run-to-run thickness variations are therefore minimized, resulting in high yields of high quality coatings.

IC/5 Thin Film Deposition Controller

FEATURES	ADVANTAGES
Aggregate Rate	The aggregate rate is the effective deposition rate based on all sensors in use. Each sensor has a user-definable weight (its relative importance) and tooling factor.
Single, Dedicated Controller	Because all sensors are linked to one dedicated controller, response is fast; updates every 100 msec. This speed is essential for electron beam gun control. Monitor and rate control tasks are always performed; processing is never interrupted, because the IC/5 controller has the computer power to do all required tasks. Also, one controller takes up less rack space.
Auto Soak 2	To eliminate the rate variation at the start of a deposition, "Soak 2" power is automatically set to the previous layer's power level.
Auto Z	For increased thickness accuracy, in multiple material depositions, "Auto Z" changes the crystal's acoustic impedance ratio automatically as material accumulates on the crystal.
Control Loop Options	To accommodate various source and sweep combinations, control loop parameter options include "PID", "PI", or "non-PID" (proportional, integral, derivative). Also available is a programmable "Control Loop Delay Time" that starts control of the source after opening the source shutter. This minimizes the effects of thermal shock to the crystal and the rippled effect it has on source control.
Crystal Activity Indication	The health of a crystal can be measured by its "activity", the ability to continue to oscillate. It indicates when a crystal needs to be changed more reliably than the traditional resonate frequency approach.
Co-Deposition	The IC/5 Deposition Controller can control two sources simultaneously.



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