

THIN FILM TECHNOLOGY

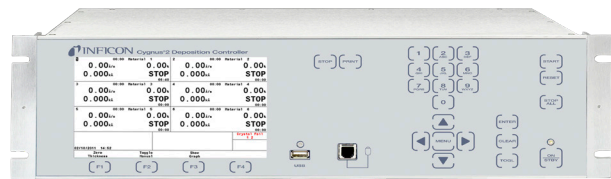
Advanced Solar Cell Manufacturing

INFICON has almost six decades of thin film experience in maximizing productivity and yield in manufacturing photovoltaic products. Continuous deposition control can be used to maximize reproducibility and uniformity by monitoring and controlling accumulated thickness in-situ and in real time, providing the best measurement resolution that does not require frequent venting. For heterojunction (HJT) solar cells, perovskite solar cells, and thin film panel manufacturing, INFICON provides market-leading thin film deposition controllers and monitors, including Cygnus[®] 2.

The Best Measurement Precision Possible

Cygnus 2 is a high-resolution controller capable of controlling six independent rates as low as 0.1 Å/s, typical of advanced solar cell manufacturing processes. This is especially useful in the OLED and solar markets as it eliminates the need for multiple controllers for tools with multiple sources. Instead of having six different deposition controllers for each chamber, one Cygnus 2 can control all six sources independently, simultaneously, or in any combination that is desired to minimize integration cost.

OLED processes consist of multiple organic materials deposited at extremely low rates, which Cygnus 2 has been very successful with controlling. Shown in the figure below is an AIQ3 sublimation controlled by Cygnus 2 with excellent rate stability. Cygnus 2 can control deposition rates for four independent AIQ3 sources well below 1 Å/s.



INFICON ModeLock technology ensures the most stable, highest resolution rate and thickness measurement available, even at very low rates.

Up to six sources can be controlled simultaneously, independently, or in any combination by one Cygnus 2, relieving the need for two or three controllers.

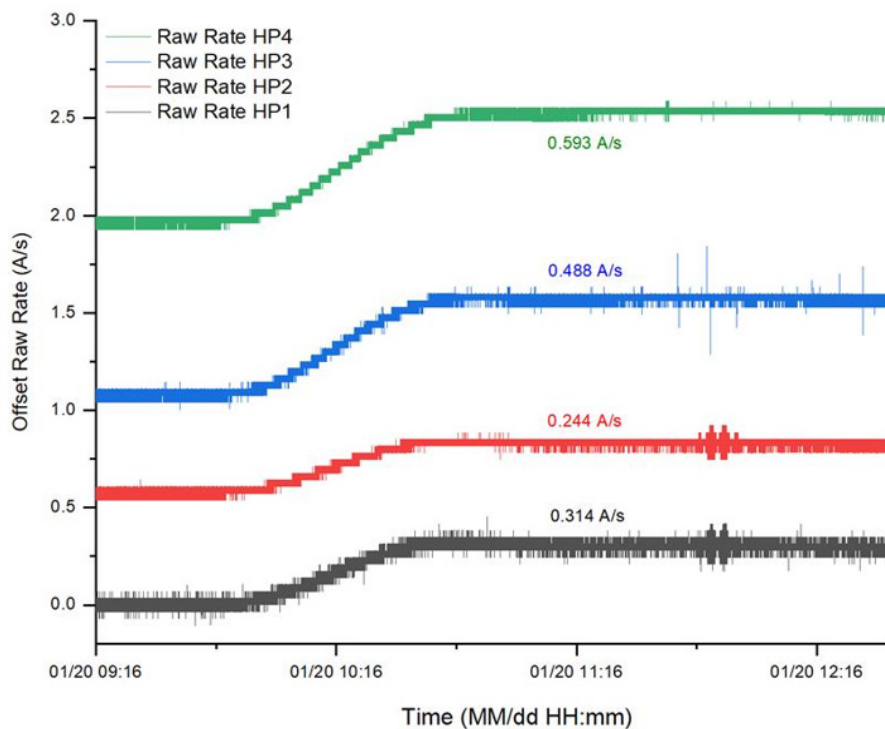


Figure 1: AIQ3 Sublimation Rate Control with Cygnus 2

Perovskite solar cell processes closely resemble OLED manufacturing, with similar tools and exotic materials. Exotic materials have no known Z-ratio, which is a required parameter for accurate QCM measurement. Generally, unknown Z-ratios are estimated using laboratory techniques and can result in thickness errors. The Auto-Z feature on Cygnus 2 can accurately and continuously calculate the Z-ratio throughout the deposition without any experimental approximation, resulting in better thickness reproducibility and yield.

ModeLock: A Frequency Synthesized, Phase Sensitive, Intelligent Oscillator

Cygnus 2 also uses ModeLock, which enables low rate control with the best accuracy. ModeLock is an INFICON patented oscillator technology where the crystal is a passive element in the electrical circuit. Traditional oscillator technologies use the crystal to jump to unwanted frequency modes. When the crystal jumps to another frequency mode, it results in a large error in thickness and can also lead to significant rate noise if the crystal is continuously switching frequency modes. The ModeLock oscillator applies a digitally synthesized frequency to the crystal and continually adjusts the frequency in order to maintain a "lock" on the fundamental frequency. By doing this, the user gets reliable frequency, 10 times the resolution and faster frequency updates which allows the user to control rates as low as 0.1 \AA/s . Incorporating the speed and precision of ModeLock with low deposition rates as seen in solar cell manufacturing processes, ModeLock oscillators will help produce higher quality films with higher throughput and yield. ModeLock also extends the monitoring time of the crystal before it needs to be changed. In most cases, the crystal will last twice as long compared to a crystal using a conventional oscillator circuit, where the energy applied to the crystal is fixed. This is extremely important when depositing any organics or oxide materials because these materials add a lot of stress to the crystal, causing the crystal to fail sooner. Therefore, by extending the crystal life, the process monitoring time is increased, leading to longer uptimes on the tool. The user can also use much longer in-vacuum cable lengths with a ModeLock oscillator for large scale production tools.



Maximizing Production Time with a Crystal 12® Sensor

A Crystal12 sensor houses 12 crystals and can automatically switch to a new crystal without interrupting the process for longer process monitoring time. Flexible cooling tubes allow for specialized sensor placement, allowing users to choose how they incorporate it into their tool.

When all 12 crystals are used, they can easily be replaced, and the user can reduce tool downtime by having an optional second carousel on standby. One unique feature of Crystal12 is, unlike many rotary sensors on the market with motor driven crystal switching systems, Crystal12 has a pneumatic drive so it does not introduce any temperature to the system that could cause unstable rate and thickness readings. Crystal12 also has an integrated resistor network for selecting specific crystal positions without the use of relays, which can simplify tool integration. Cygnus 2 is then able to track these crystal positions and report what crystals are still available for monitoring and which crystals must be replaced.



INFICON Quality Quartz Crystals: 100% Tested for Accuracy and Reliability

The crystal is one of the most critical components to a QCM system for guaranteeing stable rate and thickness measurement. INFICON manufactures its own crystals at our world class manufacturing facility in Overland Park, Kansas. By manufacturing our own crystals, we can ensure the best quality and performance. For applications with organics, alloy crystals are recommended as these will better handle the film stress associated with these materials and provide longer process monitoring. Pairing the Cygnus 2 and Crystal12 sensor with INFICON alloy crystals provide the best accuracy and longest process monitoring QCM measurement system. INFICON also has a line of specialty crystals for high precision optics, OLED, and semi applications, as well as the ability to create new variants of crystals for new applications, and offers them in a wide variety of packaging options.

For more information → inficon.com

