



# SOLVING 5 BIG THIN FILM DEPOSITION CHALLENGES FACING CONTRACT COATERS



## ANTICIPATED GROWTH IN GLOBAL COATINGS MARKETS

- Global optical coatings:  
**CAGR: 7.7%**<sup>5</sup>
- Electrically-conductive coatings:  
**CAGR: 8%**
- Hard coatings: **CAGR: 8%**
- Lasers: **CAGR: 9%**



## The Global Coatings Market Is Heating Up

The contract thin film coating industry is poised for growth, with many target markets expected to see substantial growth over the next five to ten years. The global optical coatings market is anticipated to reach \$19.7B by 2022. One major application driving this growth is consumer electronics, accounting for 30% of the total market.<sup>1</sup>

The electrically-conductive coatings market, largely driven by growth in consumer demand for electronic displays such as LCDs in TVs and mobile devices, is expected to reach \$18.9B by 2021. While growth is anticipated to be high in the Asia-Pacific region, these markets are also facing high capital equipment costs as initial barriers to entry.<sup>2</sup>

Additionally, the hard coatings market is seeing significant growth. These coatings, which improve durability and can reduce maintenance, are deposited via physical vapor deposition (PVD) or chemical vapor deposition (CVD). They are seeing increased demand partially due to growth in automotive and industrial manufacturing, and the market is expected to reach \$1.35B by 2026.<sup>3</sup>

And according to *Laser Focus World's* annual market report, the laser market, a large consumer of reflective dielectric coatings, is expected to reach \$13.06B this year, with a mix of 43% diode and 57% non-diode lasers.<sup>4</sup> **Contract coaters need to align their production platforms to take advantage of these growth opportunities.**

## The Evolving Challenges of the Market

Every day on a contract coater's production floor is different, since they tend to support multiple customers and many end-user applications. This high mix/low volume environment means a coater needs to apply coatings quickly and reliably, perhaps using multiple technologies, and perform lots of smaller runs, switching easily to meet the dynamic needs of their customer base. The contract coating industry is all about speed and flexibility, and coaters can't be held hostage by the limitations of a system built for large-volume production. Throughput is important, but system utilization is paramount.

These requirements need to be top of mind when considering new capital equipment. When a contract coater chooses a thin film deposition system starting with a hardware list rather than an application-specific approach that begins with the desired end results, they risk losing their investment on a system that won't hold up when put to the test.

Using a tools integrator or a "bucket of parts" approach works well for R&D but may not have the flexibility and ease of use needed. These ETO (engineer-to-order) systems can make sense in a production environment for specific high-volume applications, but unless carefully specified and architected, many will not have the flexibility for rapid switching between applications. And since these systems are "one-offs", they will not have a production-proven track record of reliability.

Over the last few decades, the production of simple films has moved to lower-cost labor countries. The coating work that remains in countries like the U.S. is, by default, more technically challenging. This trend is driving an industry-wide move toward thin film solutions that leverage multiple deposition technologies, delivering high performance and maximum flexibility.



And finally, most contract coaters are small, independent businesses, not large, publicly-held corporations. As a result, cash flow is likely a significant consideration. Capital equipment is a large cash expense, and acquisition costs can pose a real barrier to market entry or expansion.

Given these challenges, how can a contract coater optimize their thin film deposition solutions to reach their own growth goals? Here are five solutions to look at:

## 5 Solutions That Contract Coaters Need from Thin Film Deposition Vendors



### 1. Flexible systems:

By investing in the most flexible systems, contract coaters are able to adapt to dynamically-changing customer requirements, including tackling different deposition technologies as needed. They should look for solutions that are suited to runs of various sizes and shapes, to avoid getting locked into systems that only produce large runs of one substrate. This will drive ROI, as the company gets **more use from a single system**.



### 2. Customizable solutions built on standardized platforms:

This best-of-both-worlds approach gives the benefits of an application-specific configuration built to specific process needs without the long lead-times, limitations, and reliability concerns of ETO, making it **much faster to get into production**. System flexibility is enhanced by not restricting to one application - optical films can span a much greater range than one or two applications.



### 3. Proven, reliable equipment from a true partner:

Capital equipment is a significant expense. Contract coaters can't afford to invest in a solution that isn't robust and reliable enough to keep up with the pace of business. Systems need to be proven in the field, with performance specs to back them up. And thin film solution providers should be dedicated to supporting not only their system but also their partner - the contract coating company. The right partner will have **deep process knowledge**, take the time to understand how their solution fits into the coater's business, and assess needs to make recommendations, not just deliver on provided hardware specs. Finally, their dedicated field support team should ensure that their systems are delivering high uptime and performing as promised.



### 4. Low cost of acquisition:

This isn't as simple as finding a low-priced deposition system. Acquisition costs don't stop at the system price; they include installation expenses as well as time to reach manufacturing qualification. A low-priced tool might seem great today, but if it takes years to qualify for manufacturing and needs upgrades to meet required performance (a particular concern with used equipment), long-term (and short-term) ROI will plummet. To ensure high ROI over the life of the equipment, look for a thin film deposition system provider who leverages their process knowledge to offer **flexible solutions at a low Total Cost of Ownership** for the end markets being targeted. Be wary of vendors who are moving into new markets with oversized, overpriced, inflexible solutions that cost more and have higher running costs yet can't keep up with customer needs.



### 5. Expertise in sources & controls:

Sources and in-situ controls are required for creating precision films. They offer excellent control of species during film deposition and precision thickness control to **deliver tight control over the process and resulting specs**. To ensure that sources and controls are tightly integrated for maximum benefit, look for a thin film deposition solution vendor with this expertise in-house, instead of seeking out parts from a third company to add to the system.

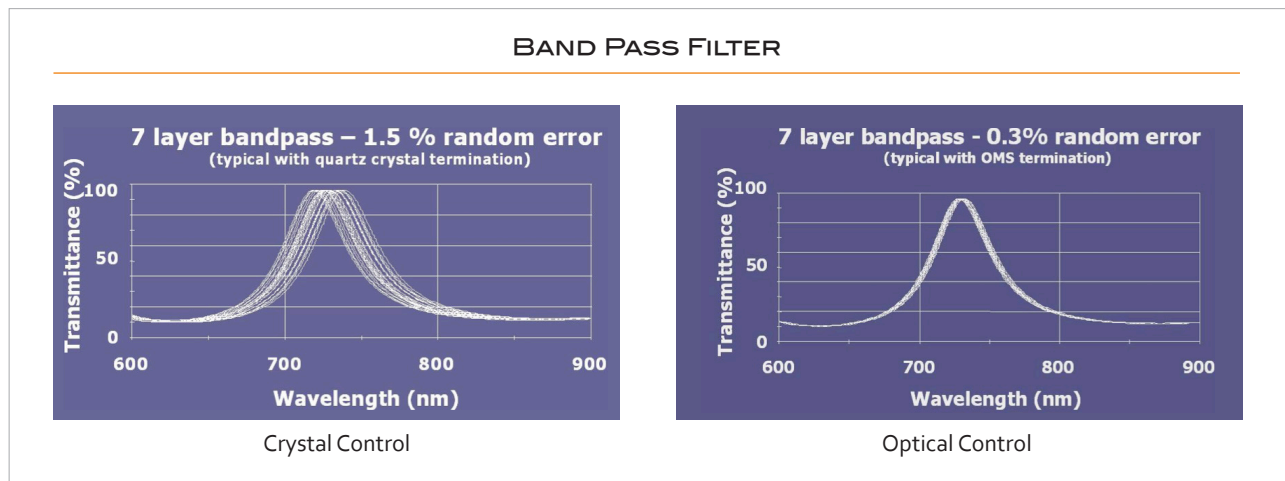


## A Deeper Look at Sources & Controls

What does adding an in-situ control or ion source to a thin film deposition system provide? It delivers better performance and results, including higher yield and increased ROI. In-situ controls allow the user to observe the formation of thin film in real time in order to better control deposition technique, materials and processes. Real-time feedback on system performance provides tighter endpoint control over the entire deposition process. These system enhancements deliver high yield, repeatable results and maximum uptimes.

Common in-situ controls include OMS (optical monitoring systems) and PEM (plasma emissions monitoring). OMS gives tighter process control of both sputtering and evaporation by monitoring the properties of an optical thin film during deposition. Typically, this monitoring is done using either the reflection of or the transmission of light through a substrate or witness chip.

OMS helps maximize yield by controlling the deposition and achieving repeatability. It is designed to endpoint on optical thickness rather than physical thickness. The result is higher production yields on precision multi-layer optics. OMS can be used for anti-reflectance and high-reflectance, laser facets, and filters, among other applications. A comparison with QCM (quartz crystal monitor), which endpoints on physical thickness, is below.



PEM is a closed-loop magnetron sputtering control system enabling optimum film quality as well as high deposition rates compared to RF sputtering. Integration and closed-loop feedback is key to realize the full benefits of PEM. Some thin film deposition system vendors offer PEM without feedback to control the plasma and ensure proper stoichiometry. This may be of interest for R&D applications but will not provide the control needed for production.

Ion sources assist in the research and manufacture of optical devices, photonics and magnetic and microelectronic devices. They provide the ability to create precision films and surfaces within a system by producing and controlling ion species, and work well as an addition to ion assisted deposition and pre-clean processes.

A source produces ions with specific energy, chemical reactivity, current density and trajectory in order to effectively exercise control and create a specific film or surface. By controlling ion species during deposition, it is easier to obtain desired properties such as densification, optical transmission, thickness uniformity, smooth interfaces, improved adhesion and vertical sidewalls. However, there is no one “perfect” ion source. Different ion sources are suitable to different applications. Vendor process knowledge is critical to selecting the right ion source for particular use cases.

If a thin film deposition vendor doesn’t have much experience with ion sources or controls, adding these enhancements later can be challenging - the add-ons won’t be tightly integrated with the overall system. This will result in losing not only the benefits of the sources and controls themselves, but limiting future enhancements and missing an opportunity to work with a knowledgeable partner who will leverage their full expertise.





## Discover A Partner Who Delivers

Taken together, these solutions will better position contract coaters to take advantage of the coming growth in the industry. Coaters will achieve a lower cost of acquisition and better return on capital investments while discovering a partner that they can lean on for knowledge and direction when needed.

Denton Vacuum empowers contract coaters by helping optimize processes and solve production challenges while improving manufacturing yields and gaining efficiency and throughput. Process knowledge is our real differentiator. Our continued commitment to research and development of thin film technology enables predictable, repeatable performance in a wide process window.

And we see ourselves as a true partner in our customers' success - not just a tool integrator delivering on a BOM. One thing we hear again and again is that our support makes the difference. We believe in customers for life. According to a recent customer survey, "response" was frequently mentioned as one of the biggest reasons companies like working with us.

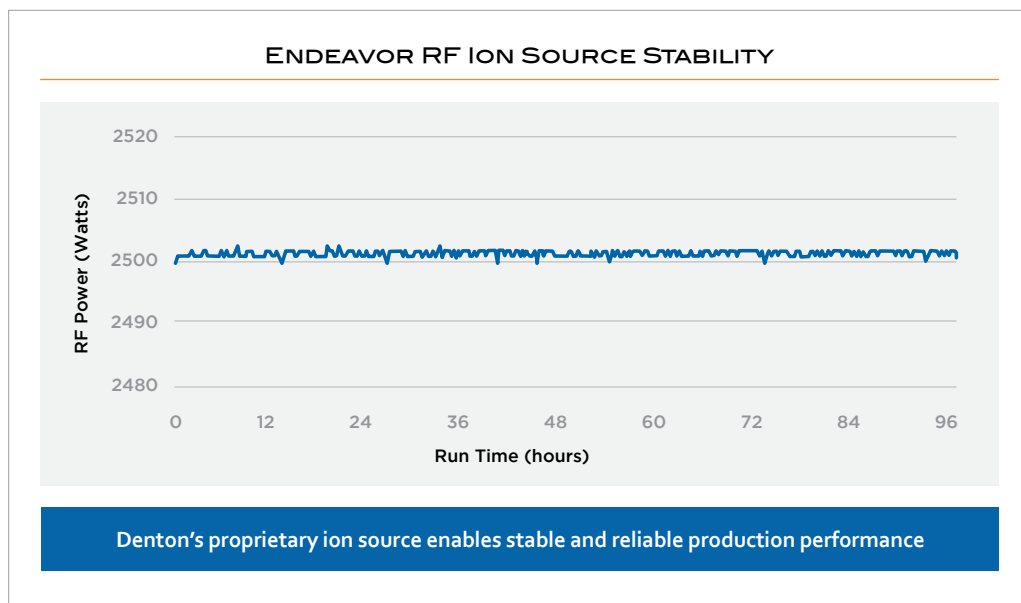
Our solutions are proven to be repeatable and consistent and are built to last a long time, delivering high lifetime ROI and low cost of ownership. Denton systems will perform as expected and be maintained via excellent customer service and support.

## Excellence in Sources & Controls

**PEM:** Our solution manages reactive gas flow by monitoring plasma characteristics and adjusting the gas setpoint based on this feedback to maintain a constant rate of deposition. It delivers tight integration within a system, providing better process control, and is especially suited for high throughput applications.

**OMS:** The LamdaPro® OMS can be configured to meet requirements for higher yield. It provides a high signal scan rate and analog to digital conversions, and is fully integrated into our Integrity evaporation system for easier usability.

**Ion Sources:** Options include the CC-105 and our brand-new Endeavor RF ion source, designed for precision optical filters. The CC-105 is designed for ion assisted deposition and pre-clean processes, while Endeavor's filament-free design enables long runs without contamination from a filament.





## DENTON VACUUM DELIVERS ON:

- ✓ Flexible systems
- ✓ Customizable solutions built on standardized platforms
- ✓ Proven, reliable equipment from a true partner
- ✓ Low cost of acquisition
- ✓ Deep knowledge of sources & controls



### About Denton Vacuum

Denton Vacuum empowers the global optics and R&D markets, helping engineers optimize processes and solve production challenges while improving manufacturing yields and gaining efficiency and throughput. Our continued commitment to research and development of thin film technology, including our proprietary integrated diagnostic systems, enables predictable, repeatable performance in a wide process window.

**Want to learn more about what Denton can do for you?**  
[Learn more about how our solutions help contract coaters.](#)

### References

<sup>1st</sup>Optical Coating Market Analysis By Product (Anti-Reflective Coating, Reflective Coating, Filter Coating, Conductive Coating, Electrochromatic Coating), By Application (Consumer Electronics, Solar, Medical, Architecture, Aerospace & Defense, Automotive, Telecommunication) And Segment Forecasts To 2022." *Optical Coating Market Size & Share | Industry Analysis Report, 2022*, Grand View Research, Feb. 2016,  
[www.grandviewresearch.com/industry-analysis/optical-coatings-industry?utm\\_source=google&utm\\_medium=cpc&utm\\_campaign=AdWords\\_optical-coatings-industry&gclid=EAlalQobChMIIMuLxabY2glVghhpCh2bkQWfEAAAYAiAAEgKDjvD\\_BwE](http://www.grandviewresearch.com/industry-analysis/optical-coatings-industry?utm_source=google&utm_medium=cpc&utm_campaign=AdWords_optical-coatings-industry&gclid=EAlalQobChMIIMuLxabY2glVghhpCh2bkQWfEAAAYAiAAEgKDjvD_BwE).

<sup>2nd</sup>"Electrically Conductive Coating Market to Reach \$18.88 Billion by 2021." *Coatings World*, 11 Nov. 2016,  
[www.coatingsworld.com/contents/view\\_market-research/2016-11-11/electrically-conductive-coating-market-to-reach-18/](http://www.coatingsworld.com/contents/view_market-research/2016-11-11/electrically-conductive-coating-market-to-reach-18/).

<sup>3rd</sup>"Hard Coatings Market Worth 1,351.3 Million USD by 2026." *Coatings World*, 10 Nov. 2016,  
[www.coatingsworld.com/contents/view\\_market-research/2016-11-10/hard-coatings-market-worth-1-351-3-million-usd-by-/](http://www.coatingsworld.com/contents/view_market-research/2016-11-10/hard-coatings-market-worth-1-351-3-million-usd-by-/).

<sup>4th</sup>"Annual Laser Market Review & Forecast: Lasers enabling lasers." *Laser Focus World - January 2018*, Jan. 2018,  
[www.digital.laserfocusworld.com/laserfocusworld/201801/MobilePagedReplica.action?pm=2&folio=42#pg44](http://www.digital.laserfocusworld.com/laserfocusworld/201801/MobilePagedReplica.action?pm=2&folio=42#pg44).

<sup>5th</sup>"Global Optical Coatings Market 2017-2021." *Global Information, Inc., TechNavio* (Infiniti Research Ltd.), 9 Feb. 2017,  
[www.giiresearch.com/report/inf475028-global-optical-coatings-market.html](http://www.giiresearch.com/report/inf475028-global-optical-coatings-market.html).