▶ BY FRED TEETER, TEETER MARKETING SERVICES LLC

In-house coating of cutting tools is more viable than ever.

Isoflux

Layers of Control

Thanks to the likes of The Home Depot, Lowe's and Menards, DIY (do-it-yourself) is ingrained in American homeowners' minds. It may not be long before CIY, or coat-it-yourself, is entrenched in the heads of U.S. toolmakers.

With the growing availability of affordable tool-coating equipment, shop-floor tool coating is emerging as a manageable and cost-effective process. Given increasingly stringent demands from cutting tool customers for just-in-time delivery and toolmakers' desire to assume greater control over their products, something that has for years been deemed a sourced technology may soon develop into another in-house task.

We've Come a Long Way

Chemical vapor deposition and physical vapor deposition thin-film, wear-resistant coatings entered the cutting tool mainstream in the late 1960s and early 1980s, respectively. Today, they are accepted components of the overall tooling "system" that combines those materials with tool design and substrate selection and preparation. In many cases, the coating has evolved into the most important factor for optimizing the performance of certain HSS and carbide tools. In fact, a number of tool designs are only effective if coated.

Nevertheless, tools that should be coated are not, because the process is often an afterthought and sufficient time is not allotted for coating.

A way to allay this problem is in-house coating, and tool manufacturers—large suppliers as well as small- and medium-size ones—should also recognize this. They should see the move as a way to gain more control over the process and to eliminate shipping tools back and forth between themselves and the toll coater, and the risk of tools—particularly carbide ones—being damaged during shipment. Benefits can be garnered on the cost side, too.

The Price is Right

For years, large tool manufacturers and some large end users have operated in-house coating centers. They have the volume of tools to justify the capital

Above: While tool-coating equipment has come down in price, it has maintained a level of sophistication that allows "designer" coatings to be applied, as well as more traditional compositions.

expenditure (often around $1 million) and operating costs associated with running a coating center. In addition, these major companies generally have the capability and discipline to operate the sometimes complex vacuum coating systems and tool-surface precleaning and preparation lines. (The latter is critical to assuring proper coating adhesion and overall quality of the thin-film coating.)

Now, however, even medium and smaller companies can consider bringing coating technology in-house because of the recent availability of smaller PVD-coating equipment. Systems that produce quality coatings in a rapid cycle are on the market at prices from $350,000 to $800,000.

Whether a company deems these lower levels of investment practical depends, of course, on numerous business and economic factors. Volume of tools manufactured or consumed, the nature of the customer base, the availability of a quality outside coating service and a financial analysis of the payback are key considerations when assessing the viability of operating an in-house coating center.

Toolmakers need not worry about their ability to correctly carry out the coating process. Continual improvement in equipment capability and reliability—particularly as a result of the incorporation of computer controls—have made coating systems, both large and small, much more operator-friendly. In fact, in-house coating lets the tool manufacturer produce custom-tailored "designer" coating compositions for specific applications, providing unique branding opportunities.

To ensure it has this designer capability, the tool manufacturer must discuss this matter with the equipment supplier before acquiring a coating system. The system specified must be flexible enough to change from one coating composition to another and to handle the range of coating chemistries available today. This is true for single-layer coatings and multilayer compositions.

Isoflux Inc., Rochester, N.Y., is an equipment manufacturer that recently lowered the bar for capital investment for in-house tool coating. The company's ICM 10, which incorporates cylindrical magnetron technology, costs about $350,000, depending on fixturing and other requirements. It can coat up to 3 microns of TiN in 1 hour, with the entire cycle taking as little as 90 minutes.

Kyocera Ceratip

Two sputtering rings of plasma (bright circles near the outside of the overall circular image) in the chamber of a tool-coating system. The cylindrical symmetry is said to reflect how the coating completely surrounds a tool.

Isoflux

Isoflux's ICM 10 is a rapid-cycle, small-batch PVD coater. A sputtering target (inset) is shown being loaded into the unit's chamber. The targets are simple to change-out, helping to facilitate a processing rate of 128 6mm drills in less than 2 hours.

In addition, the Isoflux coating equipment is designed for rapid target changes. This includes a wide range of TiAlN coatings. Changes in the ratio of aluminum to titanium, by changing sputtering targets, can provide unique properties for a variety of applications.

This technology also permits thin-film coatings of zirconia and alumina.

Knowledge is Base Coat

A great deal of care and effort is necessary to obtain optimum coating quality. While computer technology makes operating vacuum-coating equipment easier than ever, there is still a required discipline in the area of preventative maintenance and operating procedures.

Purchasers of PVD-coating equipment are given extensive operational and maintenance training by the equipment vendors. It is then up to the purchaser to ensure that its operators understand the requirements of thin-film vacuum coatings and provide a highly disciplined operating procedure. This includes constant monitoring of the

process to ensure desired quality is maintained.

To successfully operate an in-house coating center, proper tool cleaning and pretreatment is necessary. This is the area I refer to as "interface engineering," which assures that the tool surface is optimally prepared to provide the best possible adhesion of the thin-film coating to the tool surface.

The preparation of a tool surface prior to the coating operation is significantly more demanding than for an uncoated tool. The thin films range in thickness from, say, 1 to 5 microns, with the average being 2.5 microns, or 0.0001". Thus, even minute tool-surface imperfections can be fatal to high-quality coatings, particularly with regard to adhesion.

Microburrs on the tool surface may have little effect on the performance of an uncoated tool. However, they can have a major impact on the thin-film coating, causing problems in the early stages of the machining operation.

While there is very little downside to operating your own coating equipment from an environmental aspect—the PVD thin-film vacuum-coating process is well-known as "environmentally friendly"—tool precleaning is another matter. Most process water used is in a closed-loop system, but the solid waste generated in the cleaning phase must be disposed of following local municipality requirements.

CVD coating is another matter. There are environmental issues associated with the process, and, while large OEMs are content to deal with them, smaller toolmakers and end users may not want to get involved in disposal matters.

The Bottom Line

Many of the major vacuum-coating-equipment suppliers offer a range of business arrangements for acquiring their machinery. These include renting, leasing or outright purchase.

In addition, coating managers and operating technicians can be supplied by the coating-equipment manufacturer or the end user.

The following companies contributed to this article:

Advanced Coating Service LLC
(585) 247-3970
www.acscoating.com

Creative Coating Solutions
(615) 478-0039

Isoflux Inc.
(585) 334-3230
www.isoflux.com

Paying the toll

Despite the likelihood that in-house tool coating will expand due to the growing availability of less costly coating equipment, hundreds of smaller toolmaking companies will continue to outsource the service.

For the past 20 years, the coating-service industry, particularly PVD, has shown continuous growth in North America. The industry is characterized by a limited number of large, nationwide centers, a few regional coaters and an increasing number of smaller local coaters.

On Jan. 1, 2000, the Surface Engineering Coating Association was formed. SECA includes 16 coating services companies (see list). By visiting the association's Web site at www.taol.com/seca, you can obtain information about the organization and its members.

In addition to SECA members, there is a considerable number of additional coating companies throughout the U.S., plus a number of foreign companies.

It is important to realize that PVD is really a "family" of processes and not just one technology. For example, a TiN coating from one supplier using a certain process technology may have a different coating structure than a TiN coating from another supplier. This could mean different properties of one vs. the other, leading to varying tool performances.

Therefore, it is critical to determine which coating chemistry and which specific process technology is best-suited to your tool in a particular application under specific operating conditions. Granted, this can be a tall order. It requires time and effort to conduct tests and generate and analyze data.

Service and delivery are key factors in the toll-coating business, and the standard service goal of many toll coaters is 3 to 5 days, but often tools can be processed in 24 to 48 hours.

—F. Teeter

Balzers Inc.
Amherst, N.Y.

BryCoat
Safety Harbor, Fla.

Fused Metals Inc.
Georgetown, Ontario

Gleason Cutting Tools
Loves Park, Ill.

Gold Star Coatings
West Branch, Mich.

Hardcoatings Technologies Ltd.
Tallmadge, Ohio

Ionbond Inc.
Rockaway, N.J.

Metallurgical Processing Inc.
New Britain, Conn.

National Coating Technologies
Northbrook, Ill.

Northeast Coating Technologies
Kennebunk, Maine

Richter Precision Inc.
East Petersburg, Pa.

Sputtek Inc.
Toronto, Ontario

Ti-Coating Inc.
Utica, Mich.

Toll Coating Services Inc.
Itasca, Ill.

Vapor Technologies Inc.
Longmont, Colo.

Vergason Technology Inc.
Van Etten, N.Y.

Many equipment suppliers offer a turnkey package and all the required infrastructure. This would include the appropriate cleaning line, which could add $30,000 to $100,000 or more, depending on the requirements.

Often, the tool manufacturer or end user that begins in-house tool-coating operations will evolve into a toll coater. This transition occurs when the company has coating capacity beyond that which is needed to process its own tools and decides to treat the excess capacity as a profit center and market this available coating capacity to a certain customer base or within a particular geographic area.

This outsourcing of excess coating capacity seems to mirror a growing trend by many manufacturers to market their traditional in-house technical expertise (e.g., heat treating, ion nitriding, forming technology and surface treatments) to outside customers.

About the Author

Fred Teeter is president of Teeter Marketing Services LLC, Sanborn, N.Y. He previously served as marketing director of Balzers Inc., Amherst, N.Y., and is a past president of Surface Engineering Coating Association, Cleveland. For additional information about his services, call (716) 791-8100, e-mail him at Fred@ TeeterMarketing.com or visit the firm's Web site at www.teetermarketing.com.