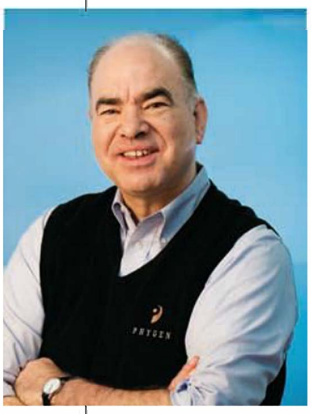
Wayne Labs, *Senior Technical Editor*

Food-safe, surface-enhancement process extends component life

The recently developed technology can extend the lifetime of grinders and other critical wear components from two shifts to many months without peeling or flaking.



David C. Bell, founder, president and CEO of Phygen Coatings, Inc.

While this surface-enhancement technology may sound too good to be true, it has been put to the test by Argonne National Labs for its durability. It also has been approved by both USDA and FDA as a food-safe coating to be used on machinery parts and surfaces that come in contact with food. The visionary for this technology is David C. Bell, founder, president and CEO of Phygen Coatings, Inc. The coating can be applied to critical wear components used in food processing equipment to improve performance and productivity, decrease operational costs and energy usage, discourage bacteria growth and reduce metal flaking into product.

For example, the dense, nanostructured, low-friction technology can be used on grinder and emulsifier plates, separators and screens, forming die plates, pump cylinders and linear shaft bearing surfaces. Phygen technology is currently being used and tested on an expanding list of new applications with success, including milk homogenizer pump systems and scraped surface heat exchanger parts.

Often, coatings have had a bad reputation in the food industry because of poor adhesion and performance problems. But the Phygen solution, branded as FortiPhy UltraEndurance coating, achieves adhesion due to a metallurgical bond to the substrate material. FE caught up with David C. Bell to learn more about this technology.

FE: What is your professional background?

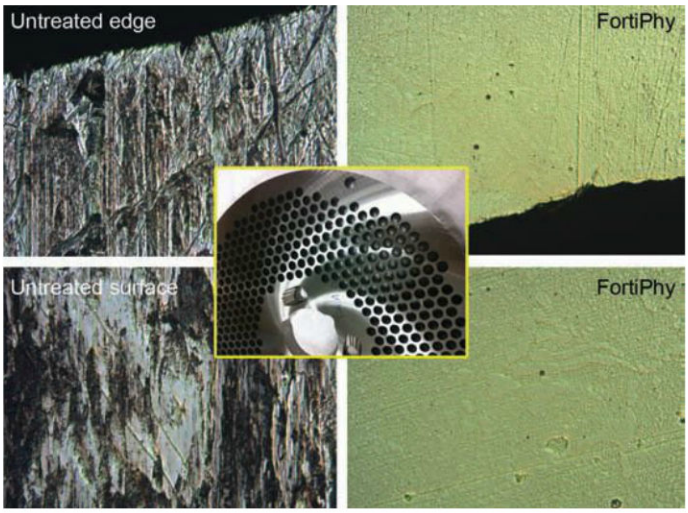
David Bell: Thirty years ago, I helped bring the gold-colored titanium nitride [TiN] coating to the world for a pioneering company. TiN was developed as a coating to enhance the performance of metal-cutting tools like drills, end-mills and hobs. I put together technology packages and, based on cost justification, sold these coating systems to companies like General Motors, Boeing, Eaton and many others in the US and around the world. Then, the company was sold, and I decided to become an entrepreneur and develop a more advanced technology. My goal was to build a company around technology that was two generations ahead of the competition. We accomplished that goal with a new technology called plasma acceleration.

FE: How did you come up with this technology?

Bell: I went on a global search for the most advanced technology in the world and found a team working on something unproven, but highly attractive in my mind because it solved the number-one problem coatings have when they are applied beyond metal-cutting tools. The new technology eliminates 90 percent of these coating flaws that prevent thin-film coatings from being effective. I then developed a business plan, raised capital and started Phygen from scratch. Because we are on the leading edge, we have been fortunate to find substantial interest in US strategic programs for the DOD, which have helped us get in position for greater success in the food industry.

FE: How does the coating process work?

Bell: The coating process is known as plasma arc acceleration, which is a major improvement on a method called cathodic arc, which is used everywhere. Cathodic arc coating is a subset of coating methods known as physical vapor deposition or PVD.



These images of a meat grinding plate (center image) with cutting-edge holes and a flat surface use 200X magnification to compare a FortiPhy-coated plate (right column) versus an uncoated plate (left column) after 23 weeks. The top pictures show the cutting edges for the holes in the plate, and the bottom pictures show the flat surface between the holes. The untreated grinding plates (left top and bottom) have plenty of pockets to allow corrosion and contamination. Source: Phygen Coatings, Inc.

With the Phygen process, we are actually creating a nitride ceramic material, which is a super hard, dense, tough thin-film coating. Think about it this way: The average human hair is about 70 microns in diameter; our coating is a mere three to four microns thick.

We take components or parts and process them in a custom, Phygen designed-and-made vacuum system following the steps necessary to create this thin-film coating. This is a modified, line-of-sight process, so we need to have the plasma "see" the parts we are coating.

FE: What were your initial intended applications for this technology?

Bell: I started the company with the objective of finding a solution for what I saw as the underserved segment of the marketplace—coatings to extend the life of machine components. PVD coatings were first developed to be applied to metal-cutting tools, and this is still the primary focus of the coating market. I decided to develop tailored coating solutions for wear and corrosion applications exclusively.

FE: Argonne Labs has been testing your technology. Why?

Bell: We wanted to have our technology judged by impartial, third-party scientists with national or international reputations. We have done that at Argonne, Lawrence Berkeley and other nationally respected US government labs. We have invested in a state-of-the-art lab located at our Minneapolis facility, sophisticated research and metallurgy tools and employee resources to fuel innovation and the creation of new nanocoatings and advanced materials.

FE: Are further tests being conducted elsewhere?

Bell: Yes, we have recently been working with Benet Laboratories, which has been researching the US Army's most demanding applications. What it found is that the plasma acceleration process and FortiPhy coating provide a new solution for replacing hard chrome plating. In Benet's tests, FortiPhy provided corrosion and wear resistance 20 times better than that of conventional thin-film coatings or hard chrome plating material. I feel this research is relevant to the needs of the food and beverage industry.

FE: Both USDA and FDA have approved and certified FortiPhy UltraEndurance for use in the food and beverage industry. What are the specific properties of this chromium nitride (CrN) coating, and how do they differ from conventional coatings?

Bell: Conventional coatings produce a large number of voids and flaws that reduce coating adhesion and create pinholes that allow corrosion and bacteria harborage. FortiPhy is dense; it consists of particles that are 14 to 40 nanometers [0.014 to 0.040 microns] in size, so the coating is extremely dense and adheres well, becoming an integral part of the substrate. Experience and controlled food plant testing have shown the surface enhancement coating pays for itself, plus offers additional cost benefits. The surface enhancement can be replaced many times. FortiPhy is inert, so it does not create adverse chemical reactions, and it is completely food safe.

FE: While a CrN coating can extend the life of machine tool parts, can it prevent metal from flaking off a grinding or cutting surface into a food product?

Bell: In a recent field trial, we determined through component wear measurements and sophisticated photographic technology that FortiPhyon grinding plates eliminate over 74 percent of metal that currently flakes into product. That's significant, but we can do even better with the continuing advancements we are developing.

FE: How can someone tell when the coating is wearing off? Can the parts be recoated?

Bell: With grinding applications, a visual inspection will reveal lighter areas on the component where the coating has worn down or off. Also, an operator can feel when the component has become dull and will see the impact on the product. We can employ our microphotographic technology for customers to see the extent and ramifications of wear. We recommend stopping the use of a coated component before its useful life is over so we can recoat it. Recoating is a very good idea for many applications. ❖

For more information: tech@phygen.com, 888-749-4361, www.phygen.com.