Thermal spray makes metal stronger, changes conductivity

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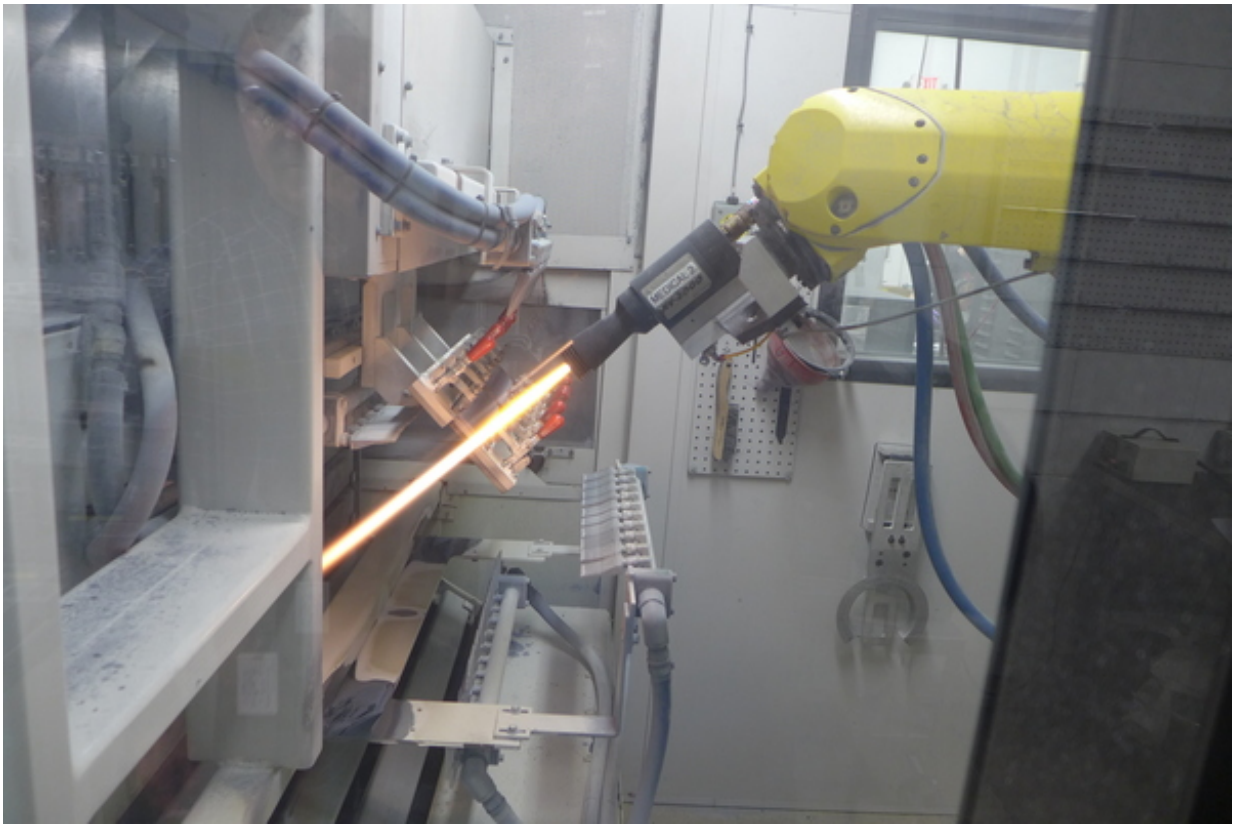

Thermal Spray Technologies uses a supersonic spray process to deposit a coating just a few thousandths of an inch thick at temperatures in the thousands of degrees. Here, the coating will alter the electrical properties of an innovative surgical device. Credit: David Tenenbaum

A company spawned by an experiment on lawn mower blades has

mushroomed into a national leader in high-temperature coatings that alter the surface properties of metal.

The coatings can change the electrical conductivity of metal or make it resist corrosion or wear. Instead of hardening an entire part that sorts wheat from chaff in a farmer's combine, Thermal Spray Technologies (TST) sprays on a layer just a few thousandths of an inch thick at temperatures in the thousands of degrees. This can, in some cases, raise a part's lifetime from 200 hours to 1,000 hours.

Thermal spray refers to several technologies used to heat and spray fine particles onto a surface where they congeal to form, in effect, a ceramic or metallic skin.

Ceramics can be tough and corrosion resistant, which means they can solve myriad problems in manufacturing. TST serves manufacturers of oil, gas and agricultural equipment, motorcycles and surgical instruments. The firm also coats valves and pumps for the food industry, parts for bicycles, and air cleaners at power plants.

TST traces its roots to Dick Wilkey, president of Fisher-Barton in Watertown. In 1984, Wilkey contacted Frank Worzala, a professor in the Department of Materials Science and Engineering at the University of Wisconsin-Madison, looking for a graduate student to develop a new coating technology.

Wilkey wondered if thermal spray could produce sharper blades, and grad student Bill Lenling took on the challenge. Although he could not figure out how to solve that challenge, Lenling spent time on the technology at Sandia National Laboratories in New Mexico, then went to work for Fisher-Barton, which is now the world's largest manufacturer of lawn mower blades.

Lenling is now founder and chief technology officer of TST, a Fisher-Barton subsidiary established in 1992 that has two facilities in Sun Prairie and about 130 employees.

"Thermal spray is usually needed where the requirement gets beyond what the component can do by itself," Lenling says. "A steel part can only be hardened to a certain level. The coating can take it to another level and still be economical to manufacture." An aluminum part can be lighter and less expensive than steel; with the right coating, it can also be more wear resistant.

"If the material melts, we have a good chance of creating a coating with it," Lenling says. "We have a plasma system that reaches 30,000 to 40,000 degrees F that can melt anything on the face of the earth."

Despite the high temperatures, "very little of the energy ends up on the part," Lenling says. "The molten drops are very small and the part is a big heat sink, so heating typically does not affect it."

Each coating material has different properties, Lenling says. "It's not just for corrosion protection or wear resistance; the coating can be biocompatible, for use in a joint implant. Or it can become electrically insulating or conductive."

The firm's coatings are used to regulate conductivity for a state-of-the-art surgical device that electrically cauterizes and seals blood vessels, replacing the traditional thread-and-needle closure. "We started with the people who invented it," Lenling says. "From the beginning, our coating was critical to making the device, which is now a multi-million-dollar product for our customer."

Getting thermal spray to work requires "a lot of science, of understanding the material and processes," Lenling says. Technology and

job requirements are always changing, he adds, and the company keeps in touch with UW-Madison as needed. For example, it collaborates with Kumar Sridharan, a distinguished research professor in engineering physics who has one of the only university-based "cold-spray" systems that can achieve some of the benefits of thermal spray while substituting kinetic energy for heat.

Engineers must design coatings for new applications, and about 20 percent of TST's employees have engineering degrees. "We were not always the first to use a particular coating technology, but for the majority of our applications, we were the first to design and develop it," Lenling says. "This goes back to our roots at the university and Sandia. We hire quite a few engineers from UW-Madison. This company is built around the scientific element."

Provided by University of Wisconsin-Madison