New Titanium Technology Center

A successful titanium metal powder process would provide components with the same strength and weight advantages has products made from large, solid pieces of titanium, at a fraction of their present cost. Currently, few industries can justify titanium's high price tag. The opportunities are tremendous for companies that can bring a viable titanium metal powder process to market.

In the fall 2006 issue of **The Shot Peener**, we reported on an alliance between DuPont and MER Corp. that was formed to develop a new titanium metal powder process. Since that time, we have discovered another very promising project. It's unique due to the expertise and scope of the involved companies and its alliance with a university.

A new titanium technology center has been created by Northern Illinois University's Rapid Optimization of Commercial Knowledge (NIU-ROCK). The ROCK Program is a joint research and development program between commercial component fabricators in the Rockford area and Northern Illinois University (NIU). The ROCK Program draws upon NIU faculty expertise to conduct research with commercial team members awarded by subcontracts.

According to a recent press release issued by NIU-ROCK, "A center being created by NIU-ROCK will use a series of new technologies for processing and shaping titanium that will cut the cost of creating many parts by 80%. The process that will be piloted by NIU-ROCK in Rockford, Illinois would lower the price of titanium to about $2 a pound by simplifying the process for making titanium powder, then compacting it into a suitable shape for final machining."

This project will be a collaboration of companies with considerable expertise and technological proficiency:

International Titanium Powder, L.L.C. (ITP)
ITP has perfected a process that creates high-quality titanium powder at a fraction of the cost of traditional methods. Specifically, the company is commercially deploying the Armstrong Process—"a breakthrough technology for the manufacture of titanium powder". The Armstrong Process produces titanium by the reduction of titanium tetrachloride through reaction with sodium. In this process, $TiCl_4$ is injected into a stream of molten sodium. The sodium flow rate is in excess of the stoichiometric requirements for sodium reduction of $TiCl_4$. The excess sodium cools the reaction products and carries them to separate stages where the excess sodium and salt are removed. The reaction product is a continuous stream of powder. With simple modifications of the process, it is possible to make vanadium/aluminum alloys.

The advantage of the Armstrong Process is that it is a relatively simple, continuous process that makes powder. Powder analysis that has been conducted on ITP's product reveals that it has met the standards for strength and ductility for commercially-pure titanium. "Relatively simple" is an understatement, as liquid sodium is very difficult to handle. Many of ITP's staff members were former employees at the Argonne National Laboratory, one of the U.S. Department of Energy's largest research centers, where they gained considerable experience in advanced science, engineering and technology.

LMC, Inc.
LMC has designed and built a machine capable of economically forming titanium powder (like that created through the ITP process) into complex parts that require little additional machining and can be used in many applications where titanium is appropriate, at a fraction of the cost of parts created through traditional methods. LMC's patented **High Velocity Adiabatic Impact** of the ITP product is creating titanium with densities of 97% and above.

Materials Modification Inc.
MMI uses a process involving tremendous pressure and plasma heat, which can further consolidate the material to near 100% density, healing minute flaws in the titanium and allowing it to meet the highest quality standards. This process is slower than LMC's but the output will meet aerospace standards.

SuperMaterials Inc.
This newly-formed company will take the lead in commercializing the MMI process. The company's goal is to deliver engineered materials solutions that provide stronger, tougher, lighter or faster competitive edge products. One of MMI's key industries is aerospace.

Of course, at **The Shot Peener**, it's all about the shot peening industry and we want to know if NIU-ROCK's success could benefit us. Alan Swiglo, Associate Director, Manufacturing Processes Research at Northern Illinois University, answered many questions for us. "Once we are in the position to make near-net-shape products or machined versions, shot peening is a likely candidate process to provide improved surface compressive residual stresses. That may be beyond the current scope of our program, but may become important later in the project or in a potential follow-on project", said Mr. Swiglo.

Mr. Swiglo is a metallurgist and has made major contributions to the field throughout his career. He is a trustee for the Gear Research Institute and serves on the metallurgy committee for the American Gear Manufacturers Association.

"Thanks for reminding me to think about the potential benefits of shot peening, as it may apply to titanium products. I am very well aware of, and have successfully used, the benefits of shot peening for critical parts such as gears, springs and chain links. Shot peening has saved a few projects for me in the past," he added.

The current status of the NIU-ROCK titanium project is the completion of demo parts by LMC. In the next year, the program is expected to be machining real parts. The new processes have the potential to impact the economies of the total titanium market—military and commercial. Not to be overlooked are the research benefits for the engineering department at Northern Illinois University and the economic boost to Rockford, Illinois. It is a win-win situation for everyone involved in the program.

And back to us: "My intuitive feeling is that shot peening will fit into the NIU-ROCK titanium project," said Mr. Swiglo.