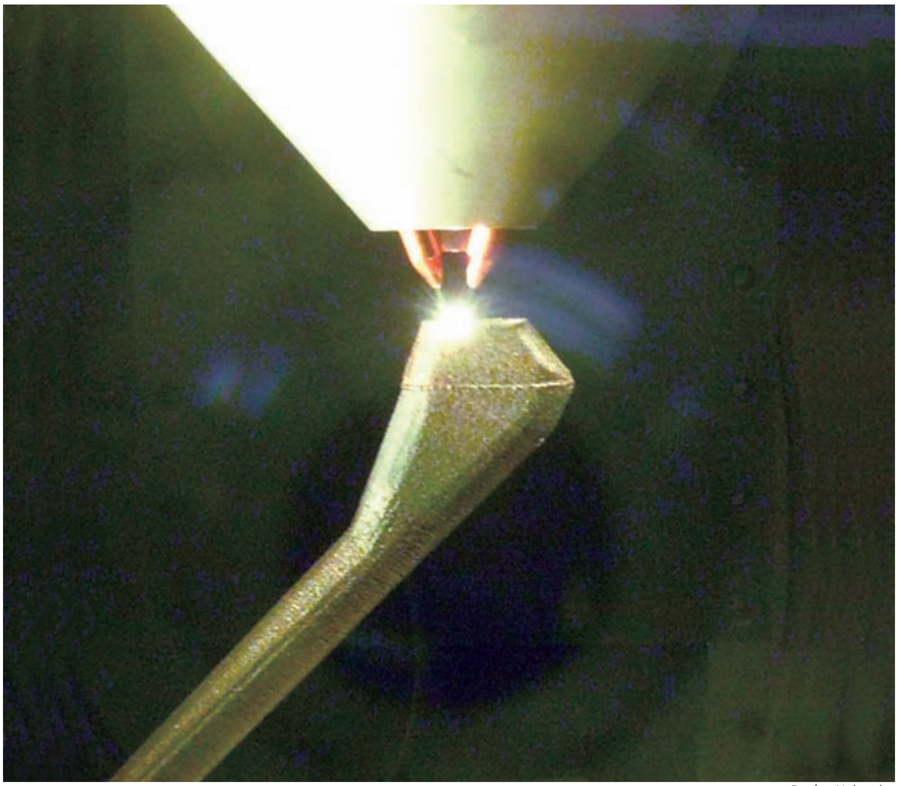
## Laser technique promises improved artificial implants

Purdue University researchers are developing technologies to make artificial implants that can be manufactured 10 times faster, last three times longer and cost less than those made with current technologies.



Purdue University

Purdue researchers are using continuous fiber lasers to make hip implants via layer deposition of melted titanium and ceramic powders.

Conventional manufacturing of orthopedic implants typically involves coating the surface of milled or molded titanium parts with a polymer material that adjoins the patient's natural bone or tissue cells, said Dr. Yung Shin, professor of mechanical engineering and director of Purdue's Center for Laser-Based Manufacturing. The polymer's life expectancy of about 10 years requires some patients to undergo several implant procedures during their lives.

Shin and his team of researchers are working to improve implant longevity by using continuous fiber lasers to melt and combine titanium and ceramic (tricalcium phosphate or hydroxyapatite) powders, which are then deposited in layers to form the implants. The highest proportion of TCP is present in the implant's porous, outermost layer, which makes direct contact with the patient's bones.

"Titanium and other metals do not match either the stiffness or the nature of bones, so you have to coat it with something that does," Shin said. "However, if you deposit TCP on metal, you don't want an abrupt change of materials because that causes differences in thermal expansion and chemical composition, which results in cracks. One way to correct this is to change the composition gradually, so you don't have a sharp boundary."

Since TCP degrades at a much slower rate than polymer materials, Shin estimates the TCP-coated devices can last at least 30 years, or three times longer than current implants.

The laser deposition process also enables the researchers to make custom parts with complex shapes. "Medical imaging scans could just be sent to the laboratory, where the laser deposition would create the part from images," Shin said. "Instead of taking 30 days like it does now, because you have to make a mold first, we could do it in 3 days. You reduce both the cost and production time."

Though Shin and his team of researchers are still refining their laser-based technology, he said it should be ready for commercialization in 2 years.

## Researchers devise microreactor from fused silica

Cornell University researchers used high-purity fused silica to fabricate a microreactor capable of withstanding temperatures of 1,100° C. An initial application for the device, which has an area of less than 3 sq. cm, is detecting athletes' use of performance-enhancing drugs.

While such testing today is widely conducted with larger-scale technology, shrinking its size to microdimensions can cut testing time by three times (down to 10 minutes) and reduce the amount of chemical preparation needed for analysis, said Tom Brenna, Ph.D., a professor in Cornell's Division of Nutritional Sciences, who coordinated the project.

"The reactor that is currently used commercially is a fixed ceramic tube with an internal diameter of 500µm and a length of about 12"," Brenna said. To conduct steroid doping tests, the tube (containing steroid molecules) is placed in a 6"-long furnace, which subjects the steroid to temperatures of about 1,000° C. The combustion reaction prepares the steroids for stable isotope analysis, allowing testers to distinguish between naturally occurring and synthetic testosterone.

As Brenna and his team of researchers set out to minimize the size of the microreactors to reduce cycle time, they realized the conventional ceramic composition wouldn't work. "As we reduced dimensions, the materials and components we had available became very fragile and were not suited for routine use," Brenna said. "That's why we went