

AdditiveFabrication

PROTOTYPING POWER

Material advancements and lowering price points fuel the additive fabrication fire as 3-D printing increases its presence in the marketplace.

by David Mantey

“There is still a lot of work that needs to be done in the area of materials,” says Terry Wohlers, principal consultant and president of Fort Collins, CO-based Wohlers Associates. According to Wohlers, if you compare the materials currently used in additive fabrication (rapid prototyping, 3-D printing) to the wide range of thermoplastics that are available, it’s the same as comparing plastics to metals in the 1960s.

Back then, everything that was supposed to be durable was made out of metal, if it was made of plastic it was considered substandard. Plastic durability and dependency has come along way over the years as the result of ongoing research and development. Similar to the development of its predecessor, the materials used for additive fabrication will continue to make exponential progress as developers apply the lessons learned as we evolved from metal- to plastic-dependency.

“We’ve seen steady growth [in material development],” says Wohlers. “We’d like to see more, but I don’t think it’s going to take 45 to 50 years to get where we’re at with thermoplastics. We have set that experience with plastics so we can apply that knowledge and experience to these processes.”

While tensile strength of ABS, ABS blends, polycarbonate, polyethersulphone, et cetera continues to increase, the industry is still looking for improvement. “I talk with customers and they still have a strong appetite for better materials, especially in the area of manufacturing,” says Wohlers. “There are a lot of materials that are good enough for models and prototype parts, but not if you want something that is going to be on a vehicle (ground or air) where a break can be catastrophic.”

Currently, many parts created using additive fabrication are being used as non-structural parts on planes. Hundreds of parts are also being used on military aircraft. “We’re beginning to see them being used in areas that were once unthinkable,” adds Wohlers.

Ongoing development has lead to strides in ABS, polycarbonate, PCABS and a wide range of Nylons (Nylon 11 and 12), as well as some filled nylons for laser sintering, among other materials. Titanium and cobalt-chrome are two metal powders that have seen dramatic improvements as a result of industry demand. “Titanium and cobalt-

chrome are getting a lot of attention both on the research and development side as well as on the buying side,” Wohlers says. “People are buying the cobalt-chrome for medical applications and the strength to weight ratio for parts has titanium growing in popularity.”

Titanium is used in the dental industry, as is cobalt-chrome which has seen a dramatic amount of work and interest from companies that are now building copings — the main structure of a crown or bridge.

Widening Breadth Of Application

Additive fabrication machines have continued to lower in price, the materials have improved, as have the accuracy and the speed, and improvements have been made to produce good quality models and prototype parts.

“It seems like more businesses are turning to prototyping early in their design process,” says Scott McGowan, marketing director for Valencia, CA-based Solid Concepts. “Businesses are recognizing the cost savings when you prototype early, because you discover either design errors or simple changes that you want to make in your design early in the process.”

Companies continue to use the machines to create custom and replacement parts, short run production parts as well as during break runs. While they’re waiting for production tooling they are using laser sintering to develop hundreds of parts until they receive the requisite production tools.

“Automotive and aerospace were the pioneers as far as the use of the technology, then came consumer products, sporting goods, the entertainment (gaming) industry,” says Wohlers. “The medical industry is also beginning to embrace it in a big way where they’re producing not from CAD data, but medical scan data from MRI and CT scanners to produce custom parts.” The parts are developed mostly to help teams of doctors as they prepare for maxillofacial and craniofacial reconstructive surgeries. Dentistry and the jewelry industries have taken off as well.

“It seems like more people are understanding prototyping and how it fits into their development pro-



cess," adds McGowan. "It is excellent not only for design verification, fit verification, but also for concept verification, to show people what it is that they're working on and get back feedback early and often as the project progresses."

Explosive Entertainment Industry

The growth driver in the industry has resulted from the influx of less expensive machines. "In terms of cost, capability and an office friendly type product, it's hard to draw a line between desktop and other prototyping systems,"

Wohlens reports. "For example, the systems from Objet Geometries, they use 3-D printing technology and they have systems that are down to [now under \$40,000], but they also have \$150,000 systems." According to Wohlens, the low-end 3-D printing market represented more than 70 percent of all sales last year. "It's really driving the growth of the industry."

Cost is not the only growth driver that has led to an expanding entertainment market, but also a changing business model. "If you look at how companies are now using software tools to produce 3-D model data that has non-technical, more consumer level data, a lot has happened in the past year," Wohlens states.

The use of non-CAD data has created a whole new wave of treating 3-D model content that is user-generated. A recent example includes former Microsoft VP Ed Fries and his start-up FigurePrints LLC based in Kirkland, WA. Fries started FigurePrints in December 2007 that has since built thousands of custom models based on avatars from



FigurePrints uses six of ZCorp's Spectrum Z 510 Full Color Systems to print unique avatars based on characters created from World of Warcraft, a multiplayer online role-playing game.

the cultural phenomenon World of Warcraft (WoW) multiplayer online role-playing game.

"I saw a 3-D color printer at a trade show in the gaming industry," recalls Fries on inspiration. "I knew about 3-D printing before, sometimes our artists in the gaming business use it to make sculptures of the characters they are designing, but I had only seen mono color in the past."

Fries is now tied into the Blizzard Entertainment servers and enables users to build his/her unique character. Users just go to www.figureprints.com and type in the name of the character and what server they're on and FigurePrints' custom software creates a 3-D rendering of the character that can be posed and placed on various bases. Behind the scenes, the software goes into the actual game data and extracts the geometry to create the character. The software then takes that

data and massages it into data the printer will recognize.

"We knew that there was going to be a lot of demand for this product," says Fries. "We have been able to

increase our production every month, but we still have more demand than we can produce right now. We get about 25,000 entries per month for the drawing; of those, we select a set of people to order (using a lottery system). About one in four people have a chance to order each month and we'll print about 1,500 a month." Fries added that not everyone who is selected in the lottery opts to purchase a figurine.

Regarding the sometimes brittle nature of the products, Fries adds, "We just switched to new glue that is giving us a stronger product and greater quality with better strength. ZCorp is also developing a new powder that is on the horizon and would be twice as strong as the powder we're using now. They're always evolving both their materials and their printing technology."

Think of the opportunity. More than 10 million World of Warcraft installations exist worldwide — and that's just one game. To put that in perspective, less than 2.5 million commercial CAD solid modeling seats exist worldwide. PDD

Tapping Schools

According to Terry Wohlens, principal consultant and president of Fort Collins, CO-based Wohlens Associates, about a third of the \$20,000 to \$30,000 systems are going to schools. "Not only are students coming out of colleges, but also high schools with hands on experience with using primarily the Dimension System from Stratasys and the powder-based system from Z Corp.

"These kids are coming out of school and they're already familiar with this technology's capabilities. They have ideas of their own of how the systems can be applied. It gets them excited about engineering and product development as a career [in a time when] too few people are choosing design or manufacturing for a career," adds Wohlens.

As these systems become priced under \$10,000 and \$5,000, Wohlens believes that these machines will eventually be priced in the \$100s. "If you look at the component parts that make up some of these 3-D printers, we're not talking about a whole lot more than just an inkjet printer with an added Z-axis elevator mechanism. We know that you can buy an inkjet printer for under \$100 today and, in sufficient volume, someone will try. They won't have the capabilities of the FDM and laser sintering machines, but they'll be more of an experimental research type platform."

