University lab demonstrates 3-D printing in glass

September 24 2009

This is an object printed from powdered glass, using the Solheim Lab's new Vitraglyphic process. Credit: University of Washington

A team of engineers and artists working at the University of Washington's Solheim Rapid Manufacturing Laboratory has developed a way to create glass objects using a conventional 3-D printer. The technique allows a new material to be used in such devices.

The team's method, which it named the Vitraglyphic process, is a follow-up to the Solheim Lab's success last spring printing with ceramics.

"It became clear that if we could get a material into powder form at

about 20 microns we could print just about anything," said Mark Ganter, a UW professor of mechanical engineering and co-director of the Solheim Lab. (Twenty microns is less than one thousandth of an inch.)

Three-dimensional printers are used as a cheap, fast way to build prototype parts. In a typical powder-based 3-D printing system, a thin layer of powder is spread over a platform and software directs an inkjet printer to deposit droplets of binder solution only where needed. The binder reacts with the powder to bind the particles together and create a 3-D object.

Glass powder doesn't readily absorb liquid, however, so the approach used with ceramic printing had to be radically altered.

"Using our normal process to print objects produced gelatin-like parts when we used glass powders," said mechanical engineering graduate student Grant Marchelli, who led the experimentation. "We had to reformulate our approach for both powder and binder."

By adjusting the ratio of powder to liquid the team found a way to build solid parts out of powdered glass purchased from Spectrum Glass in Woodinville, Wash. Their successful formulation held together and fused when heated to the required temperature.

Glass is a material that can be transparent or opaque, but is distinguished as an inorganic material (one which contains no carbon) that solidifies from a molten state without the molecules forming an ordered crystalline structure. Glass molecules remain in a disordered state, so glass is technically a super-cooled liquid rather than a true solid.

In an instance of new technology rediscovering and building on the past, Ganter points out that 3-D printed glass bears remarkable similarities to pate de verre, a technique for creating glassware. In pate de verre, glass

powder is mixed with a binding material such as egg white or enamel, placed in a mold and fired. The technique dates from early Egyptian times. With 3-D printing the technique takes on a modern twist.

Grant Marchelli, a UW mechanical engineering graduate student, removes a new object from the Solheim Lab printer. Marchelli led development of the first method for 3-D printing in glass. Credit: University of Washington

As with its ceramics 3-D printing recipe, the Solheim lab is releasing its method of printing glass for general use.

"By publishing these recipes without proprietary claims, we hope to encourage further experimentation and innovation within artistic and design communities," said Duane Storti, a UW associate professor of mechanical engineering and co-director of the Solheim Lab.

Artist Meghan Trainor, a graduate student in the UW's Center for Digital Arts and Experimental Media working at the Solheim Lab, was the first to use the new method to produce objects other than test shapes.

"Creating kiln-fired glass objects from digital models gives my ideas an immediate material permanence, which is a key factor in my explorations of digital art forms," Trainor said. "Moving from idea to

design to printed part in such a short period of time creates an engaging iterative process where the glass objects form part of a tactile feedback loop."

Ronald Rael, an assistant professor of architecture at the University of California, Berkeley, has been working with the Solheim Lab to set up his own 3-D printer. Rael is working on new kinds of ceramic bricks that can be used for evaporative cooling systems.

"3-D printing in glass has huge potential for changing the thinking about applications of glass in architecture," Rael said. "Before now, there was no good method of rapid prototyping in glass, so testing designs is an expensive, time-consuming process." Rael adds that 3-D printing allows one to insert different forms of glass to change the performance of the material at specific positions as required by the design.

The new method would also create a way to repurpose used glass for new functions, Ganter said. He sees recycled glass as a low-cost material that can help bring 3-D printing within the budget of a broader community of artists and designers.

Source: University of Washington (news : web)