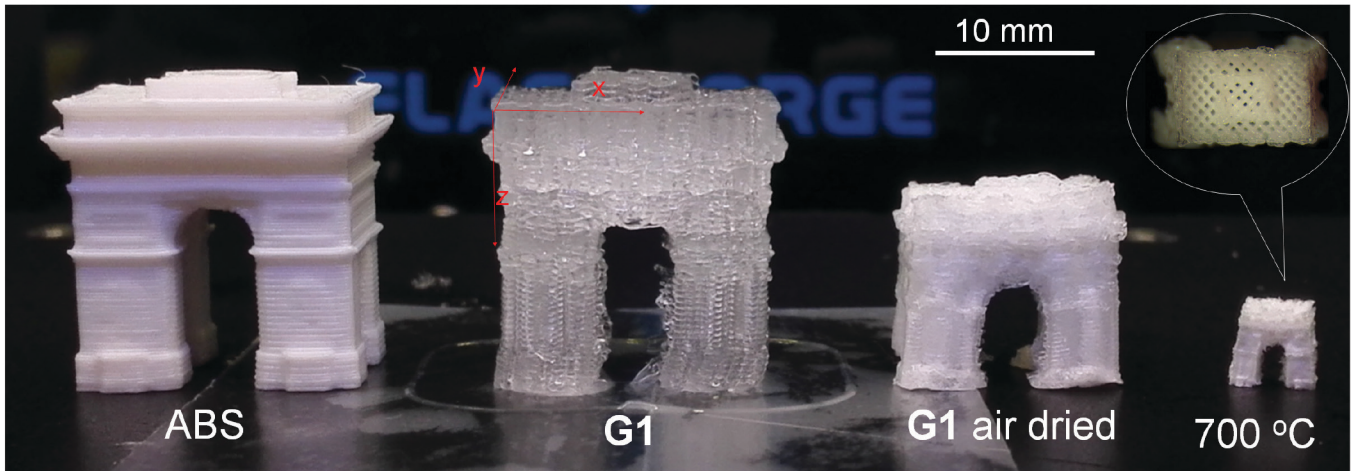


SMART INK CAN SHRINK PRINTED OBJECTS



Shrinky Dinks are a childhood toy that transforms from a large, floppy sheet to a small, hard object. Now a research lab at Dartmouth University in Hanover, N.H. has developed a material for 3-D printers that can change size or color based on surrounding stimuli.

The material, which the researchers call smart ink, may one day lead to the creation of shape-shifting 3-D printed devices, for instance, changing color if high blood sugar levels are detected and then releasing an insulin capsule. The ink could also be programmed to change the shape or size of soft robots that may be involved in rescue or medical operations.

"If we change the temperature, environment, moisture, or other stimuli,

these molecules will respond or move around. The whole object moves," said Chenfeng Ke, assistant professor for chemistry at Dartmouth. "It depends on the molecule we put into the ink."

Filaments used in 3-D printing, such as ABS and PLA plastics, are rigid. To create 3-D printed objects that could change size radically, Ke needed a flexible, low-density material. Ke's team developed a material made with hydrogel, which is as frothy as sea foam. The hydrogel "smart ink" consists of pluronic polymer mixed with smart molecules including TEOS, organosilicate, and hydrogen-bonding derivatives.

In experiments, Ke was able to shrink objects down to 1 percent of their original size. Conversely, he was able to increase

Hydrogel-based smart ink downsizes a printed Arc de Triomphe.

Image: Chenfeng Ke, Dartmouth

the size of an object. Applying ultraviolet light changed the color of one 3-D printed object from sky blue to green.

"You need to tell the molecule to align and behave like other molecules. Then you have to work out self-assembled structures. Once you work out that structure, you can control all molecules simultaneously," Ke said.

It may take some time before 3-D printers start producing adaptable objects using smart ink, Ke said. "We are still trying to figure out how we can make the material." **ME**

AGAM SHAH

GREEN APPLE

Apple, the largest company in the world by market capitalization, recently staked a claim to be among the first large companies to rely completely on renewable energy for its offices, stores, and data centers. The company has 25 renewable energy projects worldwide, generating 626 MW, and plans to build 1.4 GW in capacity. Power is drawn from hydro, wind, biogas, and other resources, but solar power dominates, with 286 MW of generation coming online in 2017 alone. Apple even has a 17-MW rooftop solar installation at its new headquarters in Cupertino, Calif. The company also claims to have reduced its greenhouse gas emissions by 54 percent since 2011. **ME**

