Researchers use 3-D printing to create structure with active chemistry

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Many materials - sugars, thermoplastics, glass, metals, ceramics and more—are used to produce 3D-printed figures, typically with expensive or custom-built 3D printers.

For the first time, researchers have demonstrated how to use commercial 3D printers to create a structure with active chemistry. Led by Matthew Hartings, American University chemistry professor, researchers created a chemically active 3D-printed structure that acts to mitigate pollution. A study outlining the process published online today in *Science and Technology of Advanced Materials.*

And it's OK to try this at home. The experiment, created with many off-the-shelf materials common to makers, hobbyists and home enthusiasts, puts the power of chemistry invention into the hands of people taking advantage of the 3D printing revolution.

The researchers designed a small structure the size of handheld sponge. They dispersed throughout plastic chemically active titanium dioxide (TiO2) nanoparticles. Using the same filament hobbyists use in the printing process of 3D-printed figures, researchers added the nanoparticles. Using a 3D thermoplastic printer, ubiquitous in manufacturing, the researchers printed a small, sponge-like plastic matrix.

Researchers had two questions: Would the nanoparticles stay active in the structure once printed? Created for pollution mitigation, would the matrix perform? The answers were yes.

Pollutants break down when natural light interacts with TiO2, which has potential applications in the removal of pollution from air, water and agricultural sources.

To demonstrate pollution mitigation, they placed the matrix in water and added an organic molecule (pollutant). The pollutant was destroyed. TiO2 also photocatalyzed the degradation of a rhodamine 6G in solution.

"It's not just pollution, but there are all sorts of other chemical processes that people may be interested in. There are a variety of nanoparticles one could add to a polymer to print," Hartings said.

One limitation of the research is that for the structure to print, the concentration of nanoparticles needed to be less than 10 percent of total mass of the structure. To have an efficient structure, a higher concentration could be needed, but depending on the need, 10 percent might be OK, Hartings said.

The structure printed for this study was a simple shape. Harnessing the power of 3D-printing, the researchers' next step will be to print many exotic shapes to understand how printed structure affects the chemical reactivity.

Because of the promising results, they've already started experimenting with different printed geometries to determine an optimal printed shape for applications that involve photocatalytic removal of environmental pollutants.

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