How to print 3D microstructures in seconds

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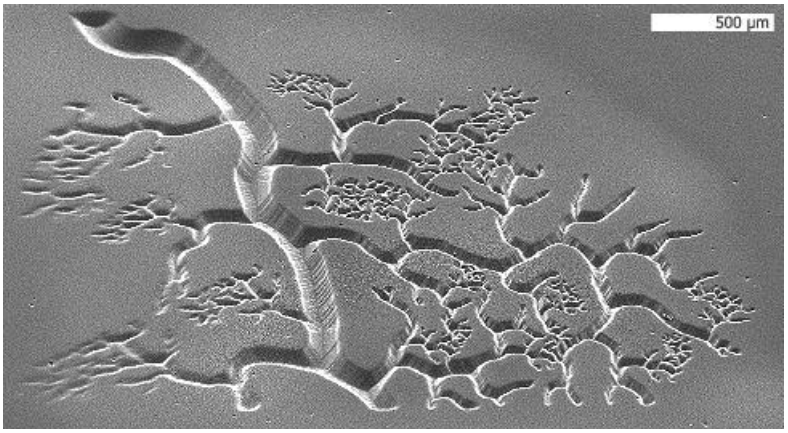

Printing three-dimensional blood vessels in seconds out of soft, biocompatible hydrogels (credit: Biomedical Nanotechnology Laboratory, Chen Research Group, UC San Diego Jacobs School of Engineering)

Nanoengineers at the University of California, San Diego have developed a novel technology that can fabricate, in mere seconds, microscale three dimensional (3D) structures out of soft, biocompatible hydrogels.

Near term, the technology could lead to better systems for growing and studying cells, including stem cells, in the laboratory. Long-term, the goal is to be able to print biological tissues for regenerative medicine.

For example, in the future, doctors may repair the damage caused by heart attack by replacing it with tissue that rolled off of a printer.

The biofabrication technology, called *dynamic optical projection stereolithography* (DOPsL), was developed in the laboratory of NanoEngineering Professor Shaochen Chen.

Current fabrication techniques, such as photolithography and micro-contact printing, are limited to generating simple geometries or 2D patterns, while stereolithography can print large objects such as tools and car parts.

The difference, says Chen, is in the micro- and nanoscale resolution required to print tissues that mimic nature's fine-grained details, including blood vessels, which are essential for distributing nutrients and oxygen throughout the body. Without the ability to print vasculature, an engineered liver or kidney, for example, is useless in regenerative medicine.

With DOPsL, Chen's team was able to achieve more complex geometries common in nature such as flowers, spirals and hemispheres. Other current 3D fabrication techniques, such as two-photon photopolymerization, can take hours to fabricate a 3D part.

How it works

The biofabrication technique uses a computer projection system and precisely controlled micromirrors to shine light on a selected area of a solution containing photo-sensitive biopolymers and cells. This photo-induced solidification process forms one layer of solid structure at a time, but in a continuous fashion.

The technology is part of a new biofabrication technology that Chen is developing under a four-year, $1.5 million grant from the National Institutes of Health (R01EB012597). The Obama administration in March launched a $1 billion investment in advanced manufacturing technologies, including creating the National Additive Manufacturing Innovation Institute with $30 million in federal funding to focus on 3D printing. The term "additive manufacturing" refers to the way 3D structures are built layering very thin materials.

The Chen Research Group is focused on fabrication of nanostructured biomaterials and nanophotonics for biomedical engineering applications and recently moved into the new Structural and Materials Engineering Building, which is bringing nano and structural engineers, medical device labs and visual artists into a collaborative environment under one roof.

REFERENCES:

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