s/" rel="category tag">3D Printers, 3D Printing, 3D Printing Materials, Medical 3D Printing |

3D printed, transplantable, functional human organs are getting closer and closer to becoming a reality, as unbelievable as that seems. While bioprinting technology hasn't quite gotten to the point of being able to actually 3D print a kidney or liver and implant it into a living human being, it's only a matter of time as multiple universities, biotechnology companies, and research institutions race to be the first to do so. It's a fascinating race to watch, not just for the obvious reasons, but because everyone's technology is a little bit different.

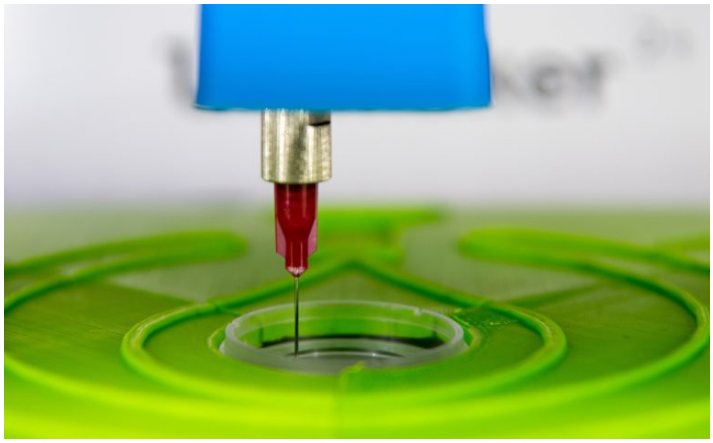
Most 3D printed tissue is created by depositing cells onto a scaffold, where they ideally grow into layers of living tissue to be used for research, pharmacological testing, or, ultimately, regenerative medicine. It's an incredibly tricky process that often fails due to a variety of reasons: the scaffold is too soft and collapses, it degrades too quickly, or it damages or kills the delicate cells. The scaffold also needs to be removed somehow once the tissue has matured, or else to biodegrade safely on its own.

Scaffold-free bioprinting is a goal that many researchers have their eyes on, but most bioprinting materials, or bio-inks, aren't strong enough to hold their structures without support. A team formed from students at Ludwig-Maximilian University of Munich and the Technical University of Munich, however, has developed what they hope will be a breakthrough in bioprinting. Team biotINK, formed for the International Genetically Engineered Machine Competition (iGEM), didn't even require special machinery for their biotINK printing process – just a simple Ultimaker 2+ 3D printer.

(L to R) Julian Hofmann, Christoph Gruber, Luisa Krumwiede and Javier Luna Mazari of the biotINK team [Image: Andreas Heddergott]

The biotINK team hacked their Ultimaker printer by replacing the extruder with a 3D printed syringe pump and programming it to extrude cells with millimeter-level precision. Just about any desktop printer can be inexpensively modified with their method, the team says (you can find detailed instructions on how to do so on Hackaday). Once they had a working bioprinter, the team set about developing a bio-ink that was not only strong enough to grow without a scaffold, but had the properties necessary for the creation of complex tissues with precisely positioned cells and multiple cell types.

The material was devised by combining biotin, also known as vitamin B7, with streptavidin, a protein naturally attracted to biotin molecules that acts as a super-strong binding agent.

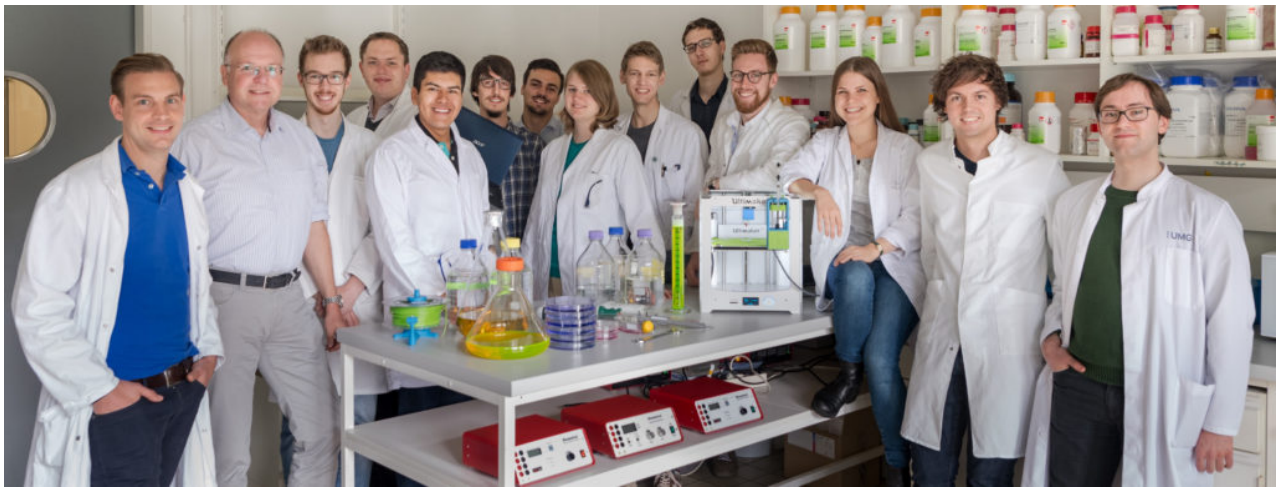


[Image: Andreas Heddergott]

> *"We are able to create three-dimensional cellular structures easily, quickly and at low cost by immediately cross-linking cells into a protein-cell-matrix upon printing," the biotINK team explains. "The interactions between cells with each*

> *other and the protein matrix are hereby mediated by the strongest non-covalent interaction found in nature – the biotin-streptavidin interaction. By using a two-component system of genetically engineered cells and proteins, we create a kind of molecular superglue that allows precise positioning of cells via bioprinting while locking them in position, allowing the formation of three-dimensional intercellular contacts and physiological microenvironments."*

The idea is for the streptavidin and biotin to polymerize and form a 3D cellular structure without the need for a scaffold of any kind. Eliminating the scaffold, not to mention being able to use a standard desktop printer to extrude the material, could make 3D bioprinting dramatically less expensive than it is now, as well as faster and simpler.



[Image: Andreas Heddergott]

Of course, no form of 3D bioprinting is exactly simple, but the students have carried out a number of experiments with their Ultimaker-turned-bioprinter and biotin/streptavidin ink, and have gotten some very promising results. One discovery they made was that the viability of cells printed with their technology was close to 100%, as opposed to about 85% with standard inkjet bioprinters and 40-80% with microextrusion bioprinters.

After the iGEM competition, which culminates today in a massive showcase of the work of over 300 teams, the biotINK team hopes to meet with investors to discuss a possible new business venture. Armed with a functional prototype and a business plan, the team believes that they could make a real impact on the pharmaceutical industry. Discuss in the biotINK forum at 3DPB.com.

Updated to add: at the iGEM competition, the team won awards for Best Manufacturing and Best Software Tool, and was the Overgrad Grand Prize Winner, as reported on the project's Twitter page.

biotINK by iGEM Munich 2016

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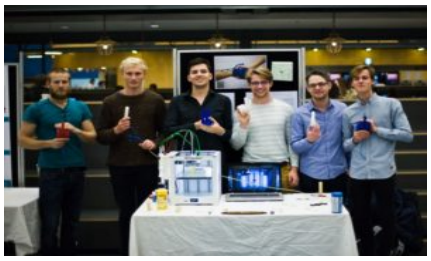

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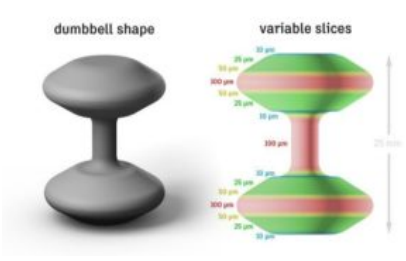

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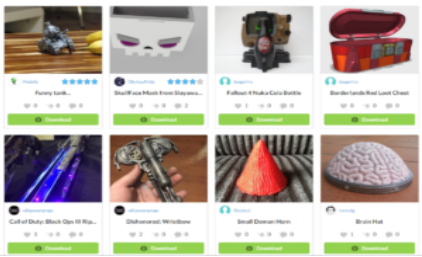

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