Liver-Inspired Device Enables Out-of-Body Detoxification

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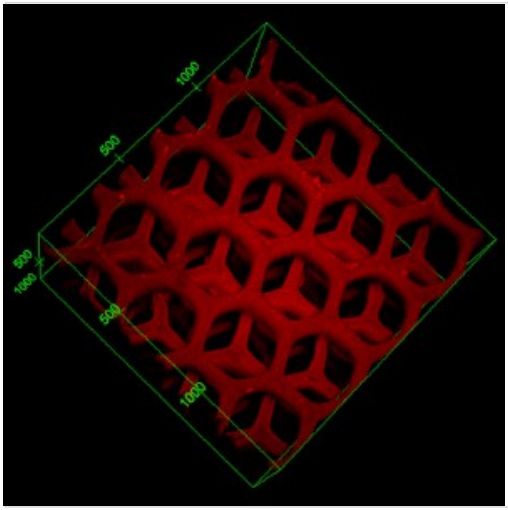

Source: University of California

A group of nanoengineers led by Maling Gou and Xin Qu at the **University of California, San Diego** (UCSD), has developed a 3-D-printed device inspired by the liver designed to remove dangerous toxins from the blood.

The device uses nanoparticles to trap pore-forming toxins (PFTs) in a device outside the body, similar to dialysis. PFTs can damage cellular membranes and play a key role in illnesses coming from animal bites, stings, and bacterial infections. The group's results have been published in ***Nature Communications***.

Rationally designed nanoparticles capable of binding toxins already have shown great promise for detoxification. However, the conventional intravenous administration of nanoparticles for detoxification can lead to an accumulation of these particles in the liver, possibly causing secondary poisoning especially in liver-failure patients.

To address this issue, the researchers have developed a liver-inspired 3-D detoxification device. This device was created by 3-D printing designer hydrogels with functional polydiacetylene (PDA) nanoparticles installed in the hydrogel matrix.

PDA nanoparticles can attract, capture and sense toxins while the 3-D matrix, designed after a modified liver lobule microstructure, is able to trap the toxins efficiently. "Our results," says Gou, "show that the toxin solution completely loses its virulence after treatment using this biomimetic detoxification device." The researchers view their work as a proof-of-concept of detoxification by a 3-D-printed biomimetic nanocomposite construct in hydrogel.

To create the 3-D matrix, the team used a photocrosslinked poly(ethylene glycol) diacrylate (PEGDA). "PEGDA is often used in biomedical applications," explains UCSD nanoengineering professor Shaochen Chen, "because it is nontoxic, nonimmunogenic, favourable to nutrient and oxygen transport, and tunable in its mechanical properties."

The modified liver lobule configuration was then printed via an advanced 3-D printing technology called dynamic optical projection stereolithography (DOPsL). This technology utilizes a digital mirror array device (DMD) to generate dynamic photomasks that can be translated into a complex 3-D structure through layer-by-layer photopolymerization of biomaterials. According to the team, the DOPsL technology has great efficacy and versatility in fabricating complex 3-D geometries for functional devices and even artificial tissues.

The researchers predict their findings could lead to the development of alternative detoxification platforms. "The cell-free nature of our detoxifier allows integration of a variety of functionalities and nanoelements in rationally designed microarchitectures," claims Chen. "This could lead to many breakthroughs in the development of future detoxification platforms."

By Ute Eppinger