MEDIA RELEASE
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Toughening up hydrogels for 3D printed cartilage

Researchers have developed a way to 3D-print tough, fibre-reinforced hydrogels that mimic the strength and suppleness of human cartilage.

Thanks to their composition (mostly water), hydrogels hold much promise for use in medical bionic applications, their softness being more readily acceptable to the body than hard materials. However, despite naturally occurring hydrogels (like cartilage) being mechanically robust, conventional synthetic hydrogels tend to be too structurally weak for many medical applications.

Shannon Bakarich, a PhD candidate at the ARC Centre of Excellence for Electromaterials Science, has come up with a solution in the form of 3D printed, fibre-reinforced hydrogels.

To create his toughened hydrogel, Shannon simultaneously prints with two inks on a 3D printer customised with a UV curing system. One ink cures into a soft and wet hydrogel and the other, to a hard and stiff plastic which forms the reinforcing 'fibres' within the structure.

"Using computer aided design software, I can make a digital model of the fibres and hydrogel matrix, tuning the mechanical properties by carefully controlling the distribution of the fibres within our structures," Shannon said.

"The printed fibres give strength to the hydrogel in the same way fibre glass gives strength to a surfboard."

The key to Shannon's success was carefully balancing the properties of the two inks so that they could be printed side by side in the same print job.

While scientists have previously used 3D printing to create fibre-reinforced hydrogels, a two-step process has been used to combine the two variations in materials. This new method uses a one-step printing process, giving greater control over the 3D distribution of the fibres in a faster and simpler process.

To demonstrate the potential of his 3D printed, fibre-toughened hydrogels, Shannon produced a knee cartilage prototype, mimicking the hydrogel and fibre structure of a real cartilage. Despite being an early prototype, the cartilage model demonstrates the potential of the process for use in developing multi-component hydrogel structures for soft robotics and medical bionics.

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Link to published paper. Co-authors: Robert Gorkin III, Marc in het Panhuis, Geoffrey M. Spinks.

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