PRESS INFORMATION

How to make hard substrates out of soft ingredients – new research findings could revolutionize stem cell technology

Physicists at Leipzig's Fraunhofer Institute for Cell Therapy and Immunology and Leipzig University have found and characterized innovative materials which may be used as adaptive substrates in cell therapy. In their research, the scientists used synthetic DNA tubes to specifically modify the mechanics of polymer networks. The scientists published their findings in the renowned specialist journal Physical Review Letters.

Networks made up of microscopic, semi-flexible polymers, which are constantly subject to Brownian motion, can be found everywhere in nature. They provide, for example, mechanical stiffness in the form of the biological cell's cytoskeleton, or create the extracellular scaffold along which the cell can move. The ability to understand and specifically modify the mechanics of this substance class permits its use as a smart substrate in which cells with the respective mechanical characteristics can be cultivated.

Until now, substrate mechanics can be modified only by changing their concentration, which severely limits the area of application. On the one hand, networks that are too tightly packed prevent the population of cells; on the other, thin substrates degrade quickly. The Leipzig researchers have now developed a material which gets around this problem. Using synthetic tubes made from DNA as polymers, they were able to control the stiffness of the contributing single molecules on the overall network. Thick and thin tubes were used to form hard and less hard structures.

"Using this method, we are able to increase substrate stiffness more than tenfold, thereby simulating different environments for cells. If the concentration is also adjusted, stiffness increases more than a hundredfold. This is a huge spectrum," explains Carsten Schuldt, physicist at Leipzig University and lead author of the publication. In the next step, we will work on making these structures even stiffer, enabling us to possibly create mechanical simulations of everything from the brain to bones. Stem cells could then be cultivated specifically for a given type of tissue. "We also have some ideas as to how the substrate can be made smart. The network could mechanically react to cell signals," says Schuldt. "Moreover, the system is excellently suited to physical foundational research. Programming mechanical characteristics in this targeted way is one of a kind," remarks the physicist.

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The Fraunhofer Institute for Cell Therapy and Immunology IZI

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