

RESEARCH NEWS

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New Biomaterials for Cell Cultures and Regenerative Medicine

Stable Biological Coating for Implants

- **The extracellular matrix (ECM) regulates all important cell functions and is an interesting biomaterial for scientists.**
- **Fraunhofer has developed an ECM that contains artificial chemical groups which supports natural cell behaviour outside the body.**
- **It can be applied as a stable coating on implants or be used in cell culture dishes.**

Biologists, chemists and physicians have to know how biological reactions occur inside the human body to be able to – for example – insert new implants, develop new active substances or to replace diseased tissue. The extracellular matrix (ECM) plays an important role in these researches. In human tissue it is the natural environment of cells and is responsible for important functions (see box). Tissue specific composition makes it the ideal material for use in medical technology. “However, it is very complicated to modify the matrix in such a way that it can be adapted to different uses, but still behave naturally”, says Dr. Monika Bach from the Department of Interfacial Engineering and Materials Science, in the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB.

Biological Coating in Medical Technology

The chemists and biologists at the Stuttgart research institute have worked together to develop a functional ECM, which supports natural cell behaviour even outside the body and which can be flexibly adapted to problems related to biology or to materials science. Prof. Petra Kluger, Head of the Department of Cell and Tissue Engineering, described the current state of the research as follows: “We have shown in the laboratory that the biomaterial fulfills its functions in spite of the additional artificial chemical groups and supports the natural behaviour of cells that are in contact with it.” The IGB scientists are currently looking for collaborators to help them to develop specific products with the patented technology. One possibility would be to coat implants so they are more rapidly accepted by the body. According to Dr. Bach, “In principle, this technology would also be interesting to develop new materials that can be used to support healing in bones or wounds.” The material could also be used to coat cell culture dishes in the laboratory. It is providing cells with an ideal environment, so that they exhibit their natural growth properties during culture. “Complex living material reacts very sensitively to even small changes in the environment”, Bach explains.

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Chemical reaction that clicks

In order to equip ECM with artificial chemical groups, the scientists exploit natural cell metabolism and let the chemical groups incorporate themselves. For this purpose, cells isolated from human tissue samples are incubated in cell culture dishes with sugar molecules which differ from normal sugars in that they have a reactive artificial chemical group at one position. The cells pick up this modified sugar and use it as a building block to assemble molecules within the cell and in the ECM. As Dr. Bach describes it, "This chemical group can then undergo a selective chemical reaction – a click reaction – with a suitable binding partner. Imagine it is like a fastener button: one half, the other half and then click!" The advantage of the clicking together is that the selective chemical reaction has a high yield, without side reactions and under physiological conditions, without interfering in natural cell processes.

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clickECM project

Within the clickECM project, scientists of the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart developed the conditions and parameters needed for the cells to incorporate relatively high levels of labelled sugar into their extracellular matrix during their metabolism. They then characterized the cell matrix and examined the influence of the functionalized matrix on cells. This "functionalized" ECM was developed together with the colleagues of the Institute of Interfacial Process Engineering and Plasma Technology IGVP of Stuttgart University. clickECM was supported by the Baden-Württemberg Stiftung and the Fraunhofer Discover Program.

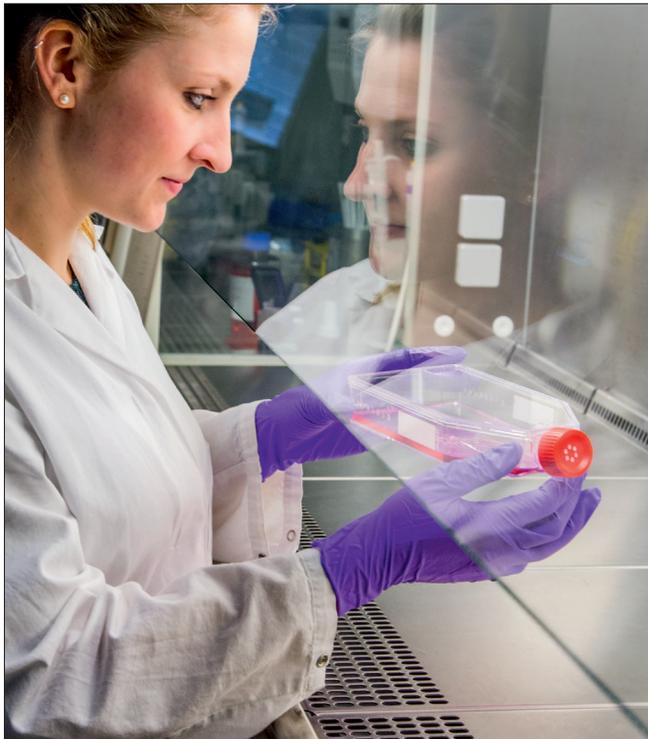
- Website of Stuttgart University: <http://www.igvp.uni-stuttgart.de/forschung/chemisch-physikalische.en.html>
- Fraunhofer IGB: <http://www.igb.fraunhofer.de/en/research/business-areas/health.html>

The extracellular matrix (ECM)

Each cell produces a tissue-specific ECM, depending on the environment needed by the cell. That of the bone is hard and contains minerals to provide firmness; however, skin ECM consists mostly of collagen and elastic fibres. The matrix consists of a three dimensional mesh of collagen, elastic fibers and proteins with carbohydrate chains. It specifies the form and elasticity of the tissue and regulates cell mobility within the matrix. The extracellular matrix participates in the assembly and regeneration of tissue and regulates all important cell functions. It triggers cell growth through chemical messengers.

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A scientist from Fraunhofer IGB cultures cells to form a functionalized extracellular matrix – the click ECM. © Fraunhofer IGB | Picture in color and printing quality: www.fraunhofer.de/en/press