Innovative coating for implants for improved ingrowth into the bone

Field of application

In a human tissue, the native human extracellular matrix (ECM) forms the natural environment of the cells. It consists of a complex network of various organic molecules and is, among other functions, involved in the construction and reconstruction of tissues. In the present technology which is designed to improve the cell-material interaction at the interface between tissues and artificial materials, in particular for implants, the high biological activity is used to improve the biocompatibility of the implant. The ECM is modified by functional groups in order to generate covalent (strong) chemical bonding to a complementary functionalized material surface. That way it is possible to generate an implant coating that is much more complex and stable in comparison to conventional biological coatings with a single biopolymer. Moreover, it improves ingrowth of the implant into the surrounding tissue due to the high biological activity of the complex ECM used.

State of the art

Implants for bone reconstruction are often made of metals such as titanium. These implant materials are perceived as a foreign body for the organism. Despite a good overall biocompatibility of the material, its integration (e.g. into the bones of the patient) is still problematic today. In order to improve integration into natural tissue, varied methods were developed to create surface structures and properties of metallic implants that are as close to the natural bone structure ("bone mimic") as possible. Examples of such methods include the design of special surface modifications or the use of coatings that imitate bone properties such as hydroxyapatite coatings. However, all these methods have disadvantages and do not lead to completely satisfactory results. Until now, it has not been possible to provide coatings with a complex biological material like ECM, in particular in terms of sufficient durability on a planar or smooth carrier material. Conventional coatings with a complex ECM have so far been based on physisorption, i.e. the attachment of biomolecules by physical interaction with the surface, which often could not generate sufficient stability.

Innovation

The Universities of Stuttgart and Constance have now developed an innovative method which allows functional chemical groups to be incorporated in the complex ECM in a natural manner by means of metabolic oligosaccharide engineering. These groups can then form stable, covalent bonds to complementary functionalized surfaces through bioorthogonal ligation reactions (so-called click reactions). This allows the creation of a non-water-soluble, click-functional ECM (clickECM) coating, which, apart from the functional groups, does not differ from the naturally occurring matrices. The material to be coated, such as titanium or other artificial materials can be functionalized with the suitable click groups by means of plasma technology or wet-chemical methods. Since the donor's own cells are used to produce the *click*ECM, no immunogenicity of the implant coating is to be feared.

Your benefits at a glance

Coating of an implant (carrier) using *click*ECM

- ✓ similar to the biological tissue
- ✓ enables stable coatings under physiological conditions
- ✓ easy production and purification methods
- ✓ personalized coating: improved tolerability as the material is made of the donor's own cells
- ✓ can be provided in a sterile manner
- ✓ can be produced inexpensively

Technology transfer

Technologie-Lizenz-Büro GmbH is responsible for the exploitation of this technology. It offers companies the possibility of cooperation and assists them in obtaining licenses.

Patent portfolio

German patent application and international PCT application are pending.

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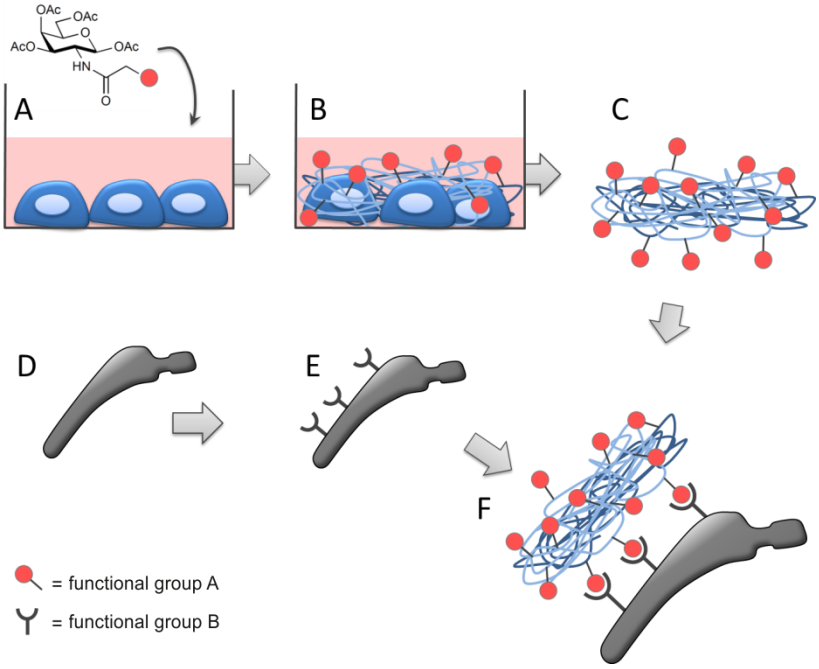

Fig. 1: By adding functionalized monosaccharides to the cell culture medium (A) an FECM (B) is created which can be isolated and purified. Titanium implants such as hip prosthesis (D) can be coated with this FECM via a covalent chemical reaction (F) after a wet-chemical modification (E).

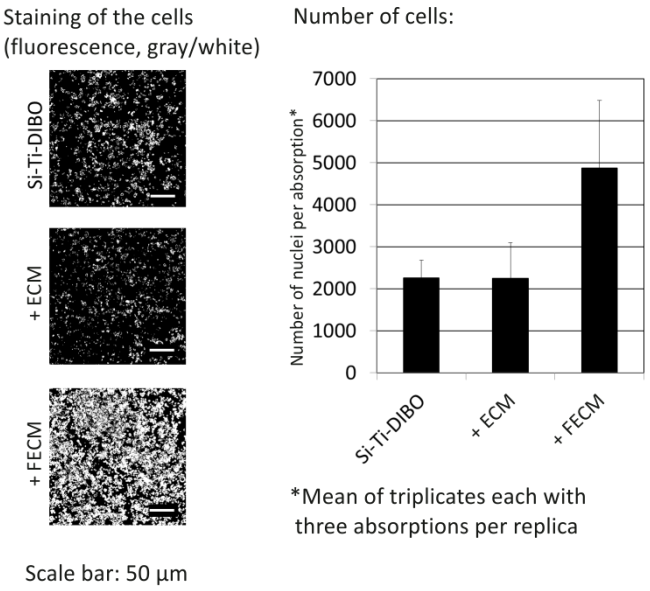

Fig. 2: Cell adhesion of primary human keratinocytes on coated surfaces. Only the FECM coated titanium substrates allow growth of more cells compared to uncoated surfaces. Coating with ECM has a low adhesion on titanium and thus does not improve cell adhesion.