**Microstructuring of Bioreactor surfaces with fine Particle Impacts for influencing Biofilm Growth**

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**Highlights**

* Surface modification of bioreactor substrates by fine particle impacts
* Distinction between elevations and indentations of the surface by adaption of the process parameters
* An Influence on the structure and growth of biofilms was observed
* Results can be used to design certain bioreactor surfaces

**1. Introduction**

The present study describes a process for microstructuring industrially relevant surfaces of titanium (ASTM grade 2) by fine particle impacts to create a specific micromorphology in the same size of biocells. This influences the cultivation of biocells, for example in bioreactors [1], which affects the composition and productivity of the biofilms formed.

**2. Methods**

Titanium surfaces have been microstructured by a cold spray setup. The particles dispersed in a nitrogen stream are accelerated to supersonic velocities (up to 900 m/s) and sprayed on a substrate. When the particles exceed a critical impact force, they bond firmly to the surface and create an elevation. If the impact force is less than this limit, the particles rebound and leave a crater. Within this study both phenomena were used to create microstructured surfaces. Titania particles (size between 0.8 and 1.5 µm) were cold sprayed on the titanium surface and created a strong bonding on the surface. This produced a surface with elevations of about 1 µm in size. In addition, titanium surfaces (grade 2) were created with crater structures only. The produces surfaces were cultivated with Lactococcus lactis biofilms in a custom built flow cell. Optical coherence tomography (OCT) was used to observe biofilm formation and morphology.

**4. Results and discussion**

SEM and Scanning probe microscopy showed a statistical distributed surface morphology, with a roughness of 40% higher than reference substrates (Sq = 200 nm). Renewed roughness measurements after ultrasonic examinations showed a strong adhesion of the particles to the surface, without any change of the roughness. Microscope images of the statistically distributed indentations show depths up to 2 microns and width up to 15 microns. Morphologically different regions of one biofilm were identified by using OCT analysis. These regions consist of either compact homogeneous biofilm or complex mushroom structures and can be related to the microstructure of the substrate.

**4. Conclusions**

A statistical distributed microstructure can be applied on the surface of technical substrates by the presented method. By selecting the process parameters it can be distinguished between elevations and indentations of the surface. An influence on the biofilm structure and the growth could be observed. These findings can be used to produce special surfaces for bioreactors.

**References**

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