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FRAUNHOFER INSTITUTE FOR ORGANIC ELECTRONICS, ELECTRON BEAM AND PLASMA TECHNOLOGY FEP

1


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1 *Electron beam equipment REAMODE*
2 *Implant with modified surface*

SURFACE MODIFICATION FOR MEDICAL ENGINEERING

Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP

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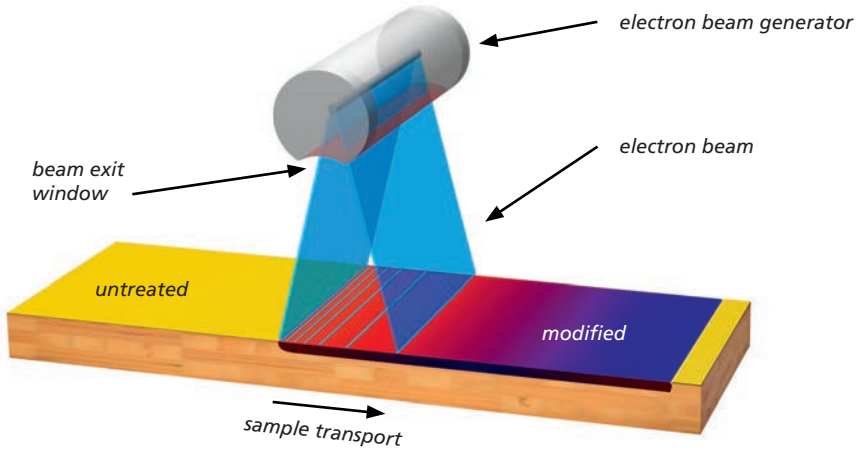
Modification of surfaces represents a broad area of applied research in medical engineering. It is possible to selectively influence the surface characteristics of a material and thus its functionality leaving its bulk properties unaltered.
In addition to plasma technology which is widely used for surface modifications, the Fraunhofer FEP works with non-thermal electron beam processes. Thereby, an electron beam initially created in vacuum is transferred to atmosphere, producing reactive species such as ions and radicals. In addition, the material to be treated is activated to a well defined depth in dependence to the applied electron energy. This causes a reconfiguration of the existing chemical bonds, producing new functionality at the surface. By variation of the process atmosphere, e.g. nitrogen or argon, further process optimizations can be achieved.
The research work of Fraunhofer FEP has demonstrated that the low energy electron beam treatment is suitable for a broad field of applications in terms of surface modification. The modification effects are stable over time and have even been able to withstand storage in isotonic saline solution. As an example, the electron beam modification can be used to generate hydrophilic surfaces. It is known that hydrophilic surfaces have a reduced bacterial adhesion and can therefore prevent formation of biofilms on implants or medical surfaces. Furthermore, partial surface treatment facilitates modification of selected areas and can be used to create for example growth patterns for human cells. Since the modification is also able to withstand conventional sterilization processes like hot steam, its utilization for biomedical applications is extremely attractive. By specific adaption of the process parameters and the process atmosphere, it is possible to systematical adapt surface functionalities.



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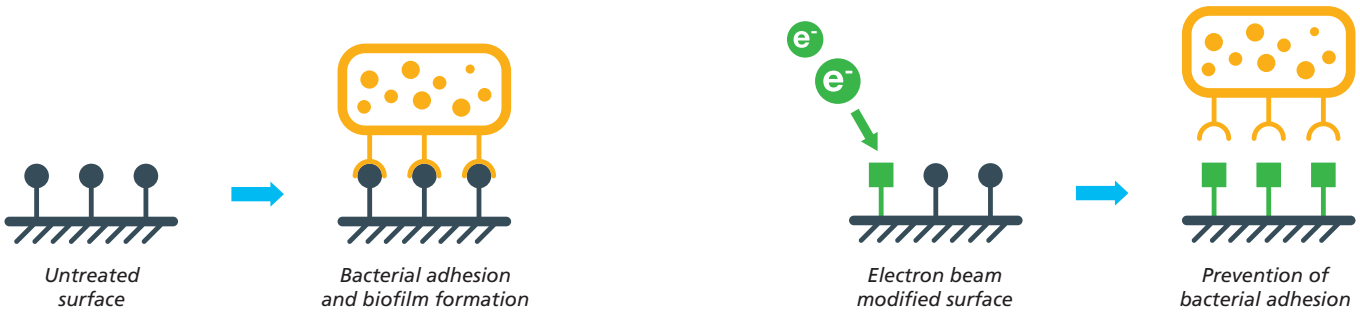
5 Bacterial adhesion on untreated and modified surfaces



Applications

- Biomedical Engineering: reduction of bacterial adhesion, easy-to-clean surfaces, prevention of biocorrosion
- Tissue Engineering: sterilization and optimization of cell attachment, guidance of cell attachment by partial modification or patterns
- Surface Engineering: grafting, compounding, crosslinking, improvement of wear and friction
- Packaging industry: improvement of labeling and sealing processes of packaging material, reduction of migrating substances, conditioning of material within the recycling process

Our offer

- Feasibility studies and technology development in the fields of surface modification for diverse applications ranging from medical applications to materials engineering
- Development of optimized process parameters (process environment, electron energy, penetration depth, etc.) for your application
- Support for cost determination and system technology implementation
- Qualification and validation by means of recognized cell biological, microbiological and surface characterization testing procedures (e.g. antimicrobial effects, cell attachment, etc.)

Advantages

- Time saving surface treatment within seconds
- Treatment of temperature sensitive materials possible, nearly no substrate heating
- Surface layer treatment only, no influence on the bulk material
- Long-term stable effect
- Partial modification and patterning of fine structures (µm range)
- Sterilization/disinfection is a positive side-effect of this surface functionalization
- Environmental friendly

3 *Electron beam surface modification*

4 *Electron beam modified wound dressing*

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