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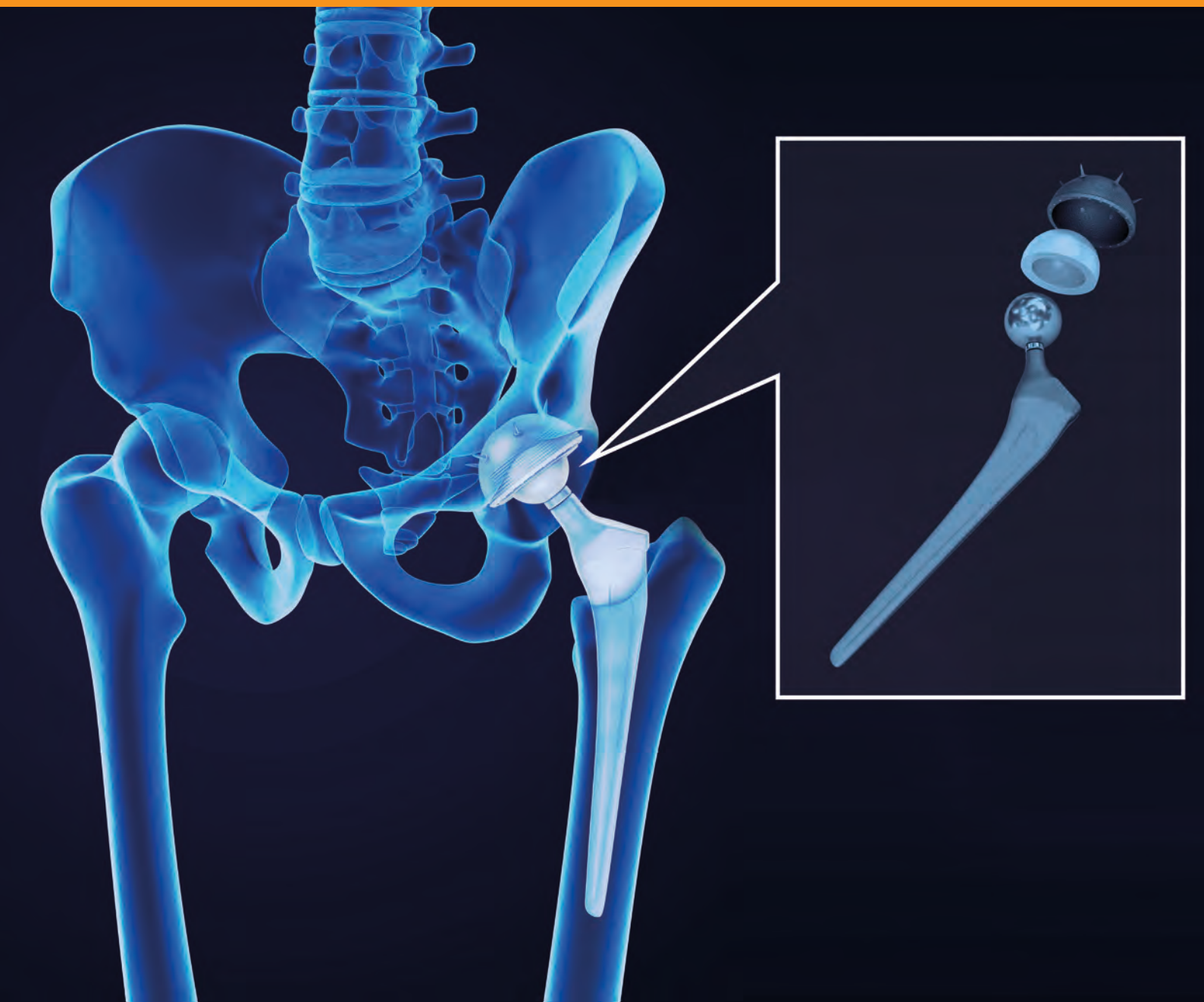
FRAUNHOFER INSTITUTE FOR ORGANIC ELECTRONICS, ELECTRON BEAM AND PLASMA TECHNOLOGY FEP

SURFACE TECHNOLOGIES FOR MEDICAL APPLICATIONS



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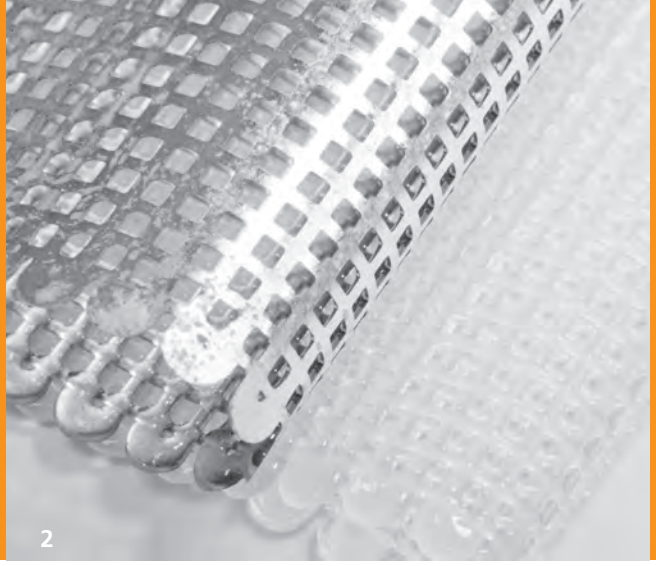

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Surface technologies for medical applications

In no other technical and scientific field innovations are so demanded and research and development is so dynamic as in medical technology. Complicated diseases, rising life expectancy, great pressure to improve efficiencies in healthcare and high patients' expectations are among the main factors that provide favorable future opportunities for companies in this economic sector. Increasingly close cooperation with research institutions is very important in this context, in order to remain innovative and highly specialized, to compete in the market with leading technologies and products.

Fraunhofer FEP has been developing technologies for surface treatment and coating as well as disinfection/sterilization for many years. They are suitable for applying biocompatible, biofunctional or antimicrobial coatings to surfaces.

This folder gives you an impression of the potential offered by our technologies. The entire portfolio is supported and evaluated for specific applications by the biomedical laboratory unit of Fraunhofer FEP. We look forward to meet you and your specific requirements.

Our offer

The Fraunhofer FEP field of activity includes feasibility studies as well as the development of pilot products/components, and can extend it all the way to developing complete key technologies. For medical applications, we can offer:

- Sterilization or disinfection using low-energy electrons, gas plasma and UVC rays
- Sterilization of sensitive products in the following product classes: plastics, thermolabile substances, organic materials and tissue with/without multiple layers, ceramics, textiles, hydrogels and electronic components – also packaged
- Virus deactivation of pharmaceutical products as well as biotechnological wastes by electron beam
- Antimicrobial effect by embedding silver/copper particles (controlled permeation and release of copper and/or silver ions)
- Electron beam treatment for structuring and treatment of barrier layers (microbe minimization, sterilization, material modification)
- Modification/optimization of biocompatibility of polymer surfaces or through passive layers
- Developing the use of transparent, conductive layers for medical applications (e. g. indium/tin oxide (ITO) and aluminum doped zinc oxide (ZnO:Al, AZO))
- Improving biofunctionality, e. g. through switchable surfaces (activatability/deactivatability)
- Photocatalytic titanium dioxide coating of medical devices and products
- Coatings to shield electromagnetic fields and electrical insulation layers to improve functionality (e. g. pacemakers)
- Grafting and cross-linking the surfaces (molecules) of polymers and biological materials against in vivo degeneration
- Reducing the biocorrosion and abrasion of implants
- Introducing specific wetting behavior with biological media

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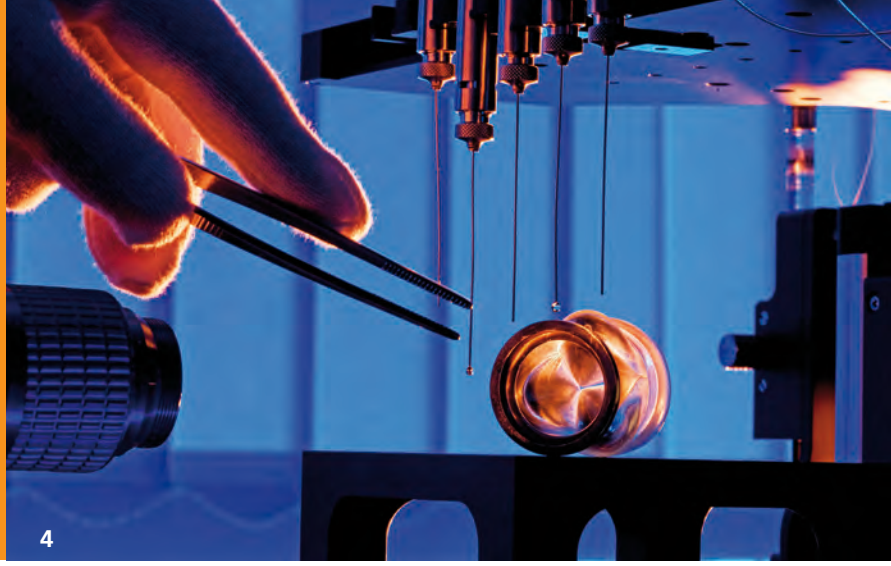

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Technologies

Surface treatment, coating as well as disinfection/sterilization and biofunctionalization technologies:

- Electron beam treatment
- Plasma treatment
- Vacuum-based processes for thin layer precipitation

Support by the biomedical laboratory unit

Microbiology:

- Proof of sterilization
- Examination of antibacterial substances, substrates and surfaces
- Evaluating the degree of microbial contamination of products
- Developing customer-specific test regimens, working with *E. coli* model germs

Cell biology:

- Examining the biocompatibility and functionality of materials and surfaces
- Cell biology examination of low-level therapy devices and sensors
- Screening culture media for tissue transplantations
- Cell viability, time-resolved, label-free cell analysis
- Examination/evaluation of healing effects

Biomedical analysis:

- Flow cytometry (FACS analysis)
  - Quantification of apoptotic, necrotic and vital cells; cell cycle studies; mitochondrial membrane potential
- Light and fluorescence microscopy, REM
  - Live-dead staining, examination of cell morphology, specific dyeing of individual cell components, cell adherence, critical point drying of biological materials and raster electron microscopy
- MTP reader technology
  - Colorimetric, fluorimetric and luminometric measurement of cell stress
- Protein and DNA/RNA analysis
  - Detection of molecular biology changes in the cell
- Thermodynamic analysis
  - Measuring the surface energy of solids and liquids, simulation models for adhesion between the cell and surface

COVER PICTURE

Coating, modification and sterilization of hip implants using EB-assisted procedures (© Alex Mit / Shutterstock, Photo montage: Fraunhofer FEP)

1 *Microbiological work in the biomedical laboratory unit*

2 *Silver coating of silicone materials*

3 *Electron beam treatment of implant screws for germ reduction*

4 *Heart valve prosthesis: innovative preparation using low-energy electron irradiation (© Thomas Ernsting)*

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