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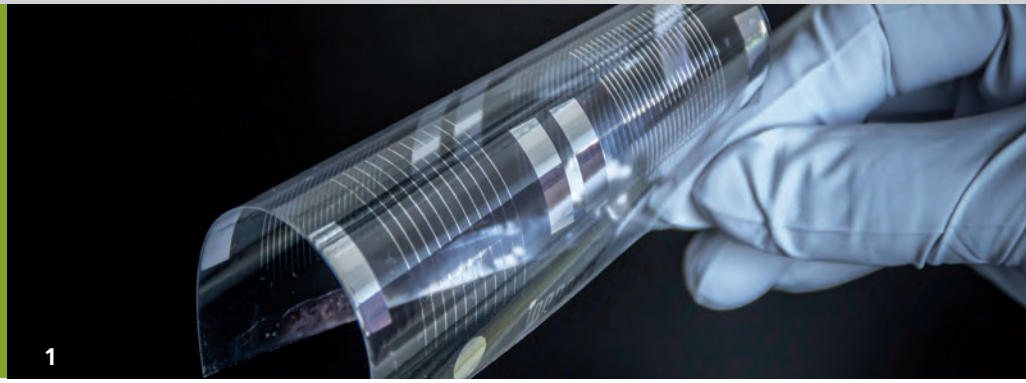

1 *Biodegradable conductor structures on biodegradable polymer foil (© Fraunhofer FEP)*

BIODEGRADABLE ELECTRONICS

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Biodegradable electronics for active implants

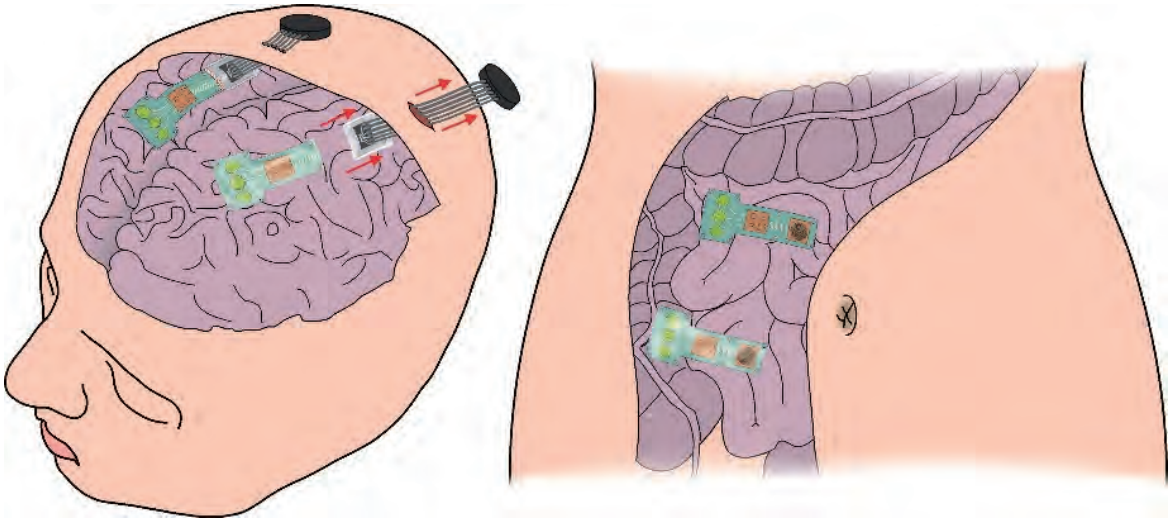
Medical implants are used for compensation of lost body functions to improve the quality of life of affected persons in a significant way. Because of the demographic development these needs will grow steadily.

Electronic components that are completely broken down in a biological environment after a pre-defined operating life open up novel applications as well as ways for reducing their ecological footprint. A novel application area for these innovative electronic components for example is in the field of active medical implants that after expiration of their operating life are resorbed by tissue, thereby sparing the patient a second surgical intervention.

Merely passively stabilizing implants, for example suture material, cardiovascular stents and bone implants have been investigated in medical research for a long time and are partially established as a product. Biodegradable electronics could enable the realization of implantable assistance systems which have an active therapeutic and/or diagnostic function with application-specific limited operating time.

Additional patient benefit while reducing costs will be expected in the field of neurostimulation, abdominal surgery and pre-surgical diagnostics. Further applications of biodegradable electronics are predicted in the agriculture sector as well as in livestock farming, biotechnology and food industry.

The aim of the current research as part of the internal Fraunhofer project "bioElektron" is the development of key components for biodegradable electronic components, which are for example used in implants.



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Technology

Fraunhofer FEP has a long and proven experience of the development of flexible (organic) electronics and barrier layers needed for this purpose.

One enabling technology for such components is the manufacture of biodegradable conductive traces on biodegradable substrates using vacuum technologies. Conductive traces and organic thin-film transistors are developed by Fraunhofer FEP.

For this purpose, magnesium is deposited by thermal evaporation in high vacuum.

Magnesium is known for being a biodegradable and biologically compatible metal that is already employed in clinical environments as an absorbable implant material.

The challenge is the deposition of this metal upon biodegradable polymer films because magnesium does not adhere sufficiently under normal process control. By suitably pre-treating the substrates using a combination of drying, plasma treatment, and utilization of seed layers, finely structured high-quality conductor structures have been produced.

Goals and forecast

In addition to the development of biodegradable conductive traces more components are developed in this project in partnership with Fraunhofer Institutes ENAS, IBMT, ISC and Fraunhofer Project Group Materials Recycling and Resource Strategies IWKS. This includes in particular:

- biodegradable conductor structures
- biodegradable electrodes for collecting electrical signals or delivering electrical stimulation
- biodegradable thin-film transistors and circuitry
- biodegradable barrier coatings as moisture and gas barriers, and electrical insulation layers

These elements will be monolithically integrated into a flexible thin-film device.

About "bioElektron"

This work is supported by the Fraunhofer Internal Program under grant No. MAVO 8313 01 ("bioElektron – Biodegradable Electronics for Active Implants")

Project partners:

- Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Coordinator)
- Fraunhofer Institute for Electronic Nano Systems ENAS
- Fraunhofer Institute for Biomedical Engineering IBMT
- Fraunhofer Institute for Silicate Research ISC
- Fraunhofer Project Group for Materials Recycling and Resource Strategies IWKS

2 *Schematic illustration of scenarios for the potential use of biodegradable active implants*
left: usage in pre-surgical epilepsy diagnostics
rechts: usage in abdominal surgery
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