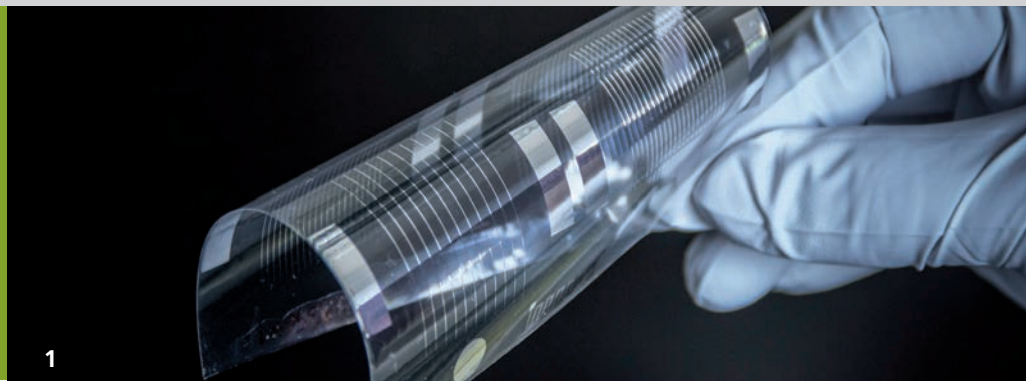
Fraunhofer
FEP

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



1 *Biodegradable conductor structures on biodegradable polymer foil*

BIODEGRADABLE CONDUCTOR STRUCTURES

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

Maria-Reiche-Str. 2
01109 Dresden, Germany

Contact persons

Ines Schedwill
Phone +49 351 8823-238
ines.schedwill@fep.fraunhofer.de

Dr. Michael Hoffmann
Phone +49 351 8823-451
michael.hoffmann@fep.fraunhofer.de

www.fep.fraunhofer.de

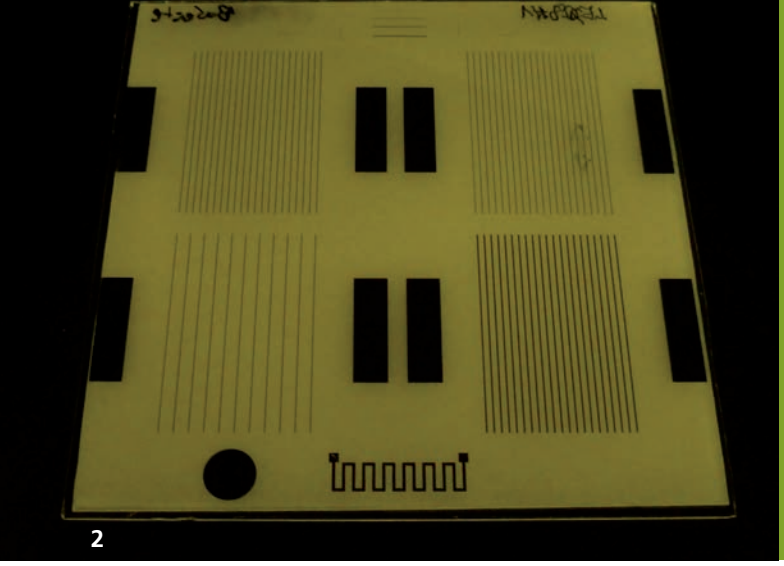
Conductor structures for biodegradable electronics

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.

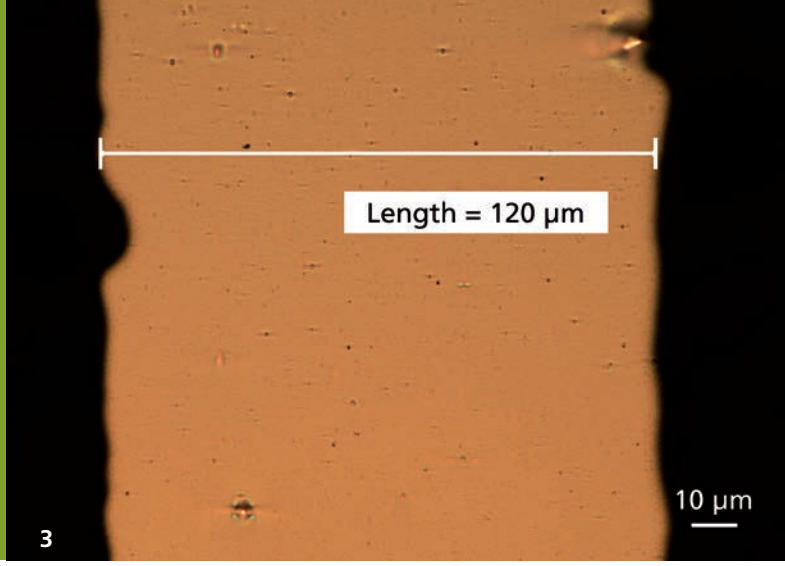
A novel application area for these innovative electronic components for example is in the field of active medical implants that after expiration of their operating life are resorbed by tissue, thereby sparing the patient a second surgical intervention.

One enabling technology for such components is the manufacture of biodegradable conductive traces on biodegradable substrates using vacuum technologies. This technology was developed by Fraunhofer FEP.

As conductor material, magnesium is used. 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 consists of depositing this metal upon biodegradable polymer films that magnesium does not adhere sufficiently to 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.



2



3

Technology

Substrate material:
- Commercial, biodegradable film (thickness here: 50 µm) based on polylactic acid (PLA)

Conductor material:
- Magnesium, deposited by vapour thermal evaporation (VTE)

Structuring:
- By shadow masks

Substrate pretreatment methods:
- Wet cleaning
- Drying (vacuum and elevated temperature)
- High energy plasma treatment (linear ion source, ion energy ~ 1 keV)
- Optional: calcium seed layers

Conductor properties:
- Sheet resistance of 2 Ohm/sq at film thickness of 50 nm (corresponds to ~ 50% of bulk conductivity)

Structure quality:
- Practically limited by adhesion properties
- Determined by pretreatment method
- Traces of width = 120 µm shown (effective resistance change by edge defects less than 20%)

About bioElektron

This work was supported by the Fraunhofer Internal Programs under Grant No. MAVO 8313 01 ("bioElektron – Biodegradable Electronics for Active Implants")

The goal of the project is the development of essential components for biodegradable electronic parts that can be employed for example in an implant.

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.

The project partners are:
- 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 Materials Recycling and Resource Strategies IWKS

2 Polymer substrate (10 cm × 10 cm, on carrier) with vapour deposited magnesium conductive traces

3 Microscopy picture of a single magnesium conductive trace of 120 µm nominal width