



- 1 *Cylindrical thermoelectric generator using screen printing.*
- 2 *Printed 3-layer piezogenerator.*
- 3 *Running an LED by means of a dispensed NFC antenna (on plastic).*

ENERGY HARVESTING USING PRINTED STRUCTURES

Smart products and systems often only require electrical energy on a local and temporary basis. By using printed structures, small amounts of electrical energy can be harvested from temperature gradients, vibrations, or electromagnetic waves (a process known as energy harvesting). The amounts of electrical energy produced by this are sufficient to power such tasks as, for example, the autonomous running of sensor nodes in order for them to be able to measure and transmit data wirelessly. Intermediate storage of this energy in (printed) capacitors or batteries is possible.

Implementation of the printing process

Printing such structures using thin-film or thick-film technologies allows the layout to be adapted and optimized for efficiency and component surface area for a great many applications. Typical amounts of energy produced by printed harvesters range up to a few milliwatts. Advantages of this process include its potential for application

to various substrates, including flexible ones, and the scalable process integration of the resource-saving printing method.

Portfolio

Fraunhofer IFAM offers the following R&D services, from the consultation stage through feasibility studies to pilot manufacturing and knowledge transfer:

- Layout and design of printed energy-harvesting structures
- Development, optimization, and selection of inks and pastes
- Printing of thermal and piezo generators and harvesting antennas on a wide range of substrates
- Technical characterization and commercial evaluation

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