Microfabrication and printed electronics on flexible substrates

Karsten Hansen and Tomasz Zawada

Meggitt Sensing Systems Denmark, Hejreskovvej 18A, Kvistgaard, Denmark
e-mail: karsten.hansen@meggitt.com

MICROFLEX project

- **EU 7th Framework Program**
- **NMP-2007-3.5.2:** Production Technologies and equipment for micro-manufacturing
- **Project full title:** Micro fabrication production technology for MEMS on new emerging smart textiles/flexibles
- **Grant agreement no.:** CP-IP 211335-2
- **Project period:** 01/11/2008 - 31/10/2012
- **13 European partners**

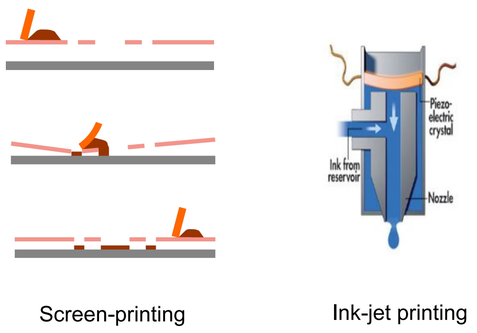
Introduction

- This paper describes the development within Microflex project, which is currently carried out under the EU 7th Framework Program. The project is dedicated to microfabrication and printed electronics on flexible substrates such as textiles or fabrics resulting in high-added value products becoming finally smart textiles.
- The developed flexible structures on fabrics are able to sense stimuli and react or adapt to them in a predetermined way. The devices developed within the project are based on fundamental micro fabrication production technologies such as thick film printing, inkjet printing and sacrificial etching for MEMS. These printing processes have many benefits including low-cost, flexibility and rapid way to manufacture a wide range of products for different applications.
- Research on active functions on textiles using e.g. piezoelectric effect is investigated. This paper summarizes the current stage of development within Microflex giving examples of a number of smart structures on textiles.

MICROFLEX project goals

- **To develop** MEMS processing capability for the production of a fully integrated flexible smart textiles
- **Process relevant aspects:** Low-cost, high productivity, clean, reliable and flexible
- **To develop** inks and pastes with new functionalities (low temperature curable making it compatible with textiles, paper, filters, fabrics)
- The Microflex project is concerned with flexible materials in the form of high added value smart fabrics/textiles which are able to sense stimuli and react or adapt to them in a predetermined way

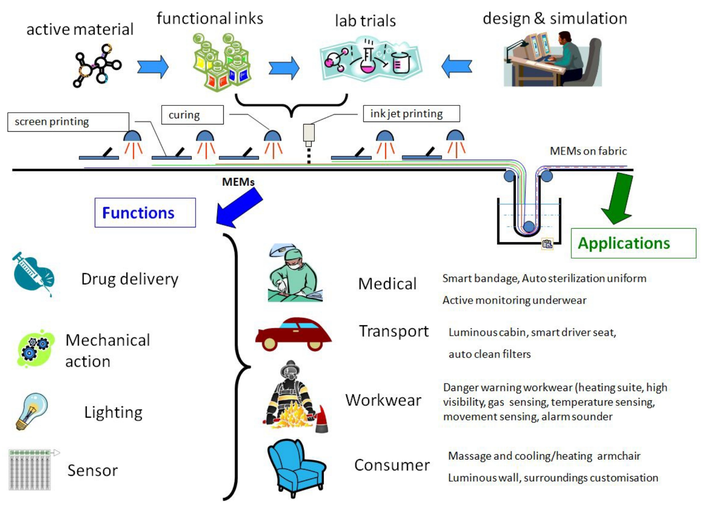
Deposition technologies



Screen-printing Ink-jet printing

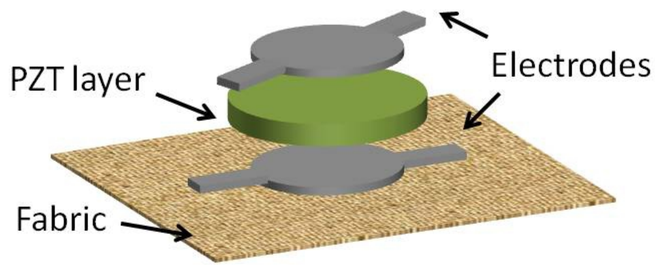
- The screen printing process is relatively simple and can be used to deposit active materials on a wide variety of substrates such as ceramics, steels, silicon and flexible substrates such as fabrics and textiles.
- Ink-jet printing is a simple non-contact technique that deposits the material in the desired pattern via a nozzle avoiding the use of screens or printing plates and is potentially compatible with many rigid and flexible substrates such as fabrics and textiles.

Production processes

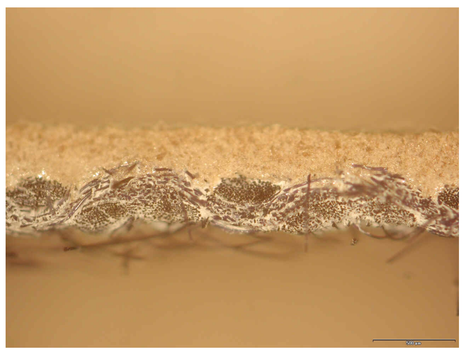


Production processes for the intelligent fabric

Structures and results



Schematic figure of layered structure



Cross section of structure

- The structure is build up layer by layer using screen-printing. The PZT thick film is sandwiched between the electrodes, bottom and top.
- PZT thick film deposited on textile using screen-printing. All processing is carried out at temperatures below 150 ºC. Characterisation and testing of the device shows promising sensitivity (d_{33} ~ 30 pC/N).

Summary and conclusions

- The presented work has demonstrated that this developed low temperature piezoelectric thick film technology can be successfully integrated into fabrics/textiles addressing a variety of applications.
- Thorough research and development of inks and pastes have been carried out and a very promising formulation has been developed, which is compatible with low temperature substrates including fabrics, textiles, paper, glass and ceramics.
- Processing of the piezoelectric material is below 150 ºC and measured sensitivity is around 30 pC/N.
- The fabricated samples were characterized using a number of methods/techniques showing promising sensitivity.

Acknowledgement

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