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Large-area smart textiles

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1. Introduction

Textiles surround us wherever we go. On our bodies as clothing, of course, but also on floors, walls and furniture, in automobiles for everything from headlining or seats to tyres–as textile-reinforced concrete, textiles are even implemented in the construction of buildings. In many of these areas, the market of technical textiles is well established and represents a rapidly growing business sector. While technical textiles make use of innovative materials like carbon, glass, conductive fibres, or nano coatings, the next big boom in the market may be the widespread introduction of electronically-enhanced textiles, which in all areas of our lives can considerably increase efficiency, and everyday safety (Marculescu *et al.*, 2003).

Today, the interaction of human individuals with electronic devices demands specific user skills. In future, improved user interfaces can largely alleviate this problem and therefore push the exploitation of microelectronic functionality considerably. In this context the vision of Smart Textiles is an example for a new class of systems aimed at applications summarized under the expression Ambient Assisted Living (Steinhage and Lauterbach, 2008; Haritaoglu *et al.*, 2000). It serves the human individual in his needs for a very convenient lifestyle. However, the implementation of a microelectronic functionality seamlessly integrated into textiles requires novel approaches both on the electronic and on the textile parts. Today, the level of cost of important microelectronic functions is low enough and enabling key technologies are mature enough to exploit this vision to the benefit of society.

In this paper, we present a newly developed key technology for the fabrication of printed Smart Textiles, as well as its first application in SensFloor®, a large-area sensor system.

2. Woven smart textile circuits

The integration of a microelectronic functionality into Smart Textiles requires all components, which are used in state-of-the-art printed circuit boards (PCBs) of the electronic devices we use today. Similar to PCBs, conductive lines for the power supply, data lines, and contact pads for the electronic devices, as well as connectors are required. If more than one layer is needed to avoid line crossings in the electronic circuit, vies between the different layers will be necessary. For wireless applications an antenna must be designed according to the chosen frequency. An interdisciplinary approach on both, the microelectronic and the textile fabrication process is necessary to develop robust and marketable systems. In research, the materials have to be selected not only according to their electrical properties, but also regarding

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