IPC-WP-024

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IPC White Paper on Reliability and Washability of Smart Textile Structures – Readiness for the Market

A White Paper Report Developed by IPC

Association Connecting Electronics Industries

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Standards Should:
- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

Standards Should Not:
- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

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Developed by the E-Textiles Committee (D-70) IPC-WP-024 White Paper Review Team of IPC

Users of this publication are encouraged to participate in the development of future revisions.

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IPC D-70 E-Textiles Committee White Paper Introduction

This white paper focuses on e-textiles with conductive silver-coated polyamide yarns. The IPC D-70 E-Textiles Committee IPC-WP-024 Review Team recognizes this white paper is a first in what could be several white papers or technical reports on washability of e-textiles comprising many different conductive technologies. The goals of these white papers are to provide peer-reviewed resources for industry knowledge exchange and to set the stage for development of reliability standards on washability through the D-70 Committee.

The D-70 Committee seeks your feedback on this white paper and your interest in writing similar white papers on your research and activities involving washability of e-textiles or any other topics.

Email white paper proposals, feedback on this white paper or issues and questions about e-textiles standards to etextiles@ipc.org.

Executive Summary

The notion of smart materials was defined in Japan in 1989. The first textile material that, in retroaction, was labelled as a smart textile was silk thread having a shape memory. The discovery of shape memory materials in the 1960s and intelligent polymeric gels in the 1970s was, however, generally accepted as the birth of real smart materials. It was not before the late 1990s that intelligent materials were introduced in textiles. First research related to communicative textiles was conducted in different laboratories in the late 1990s, and the first textile electronic semiconductive components were realized in the mid-1990s.

Smart textiles, encompassing electronics combined with textiles (e-textiles), have a very promising future in science and technology, with an interdisciplinary approach (electronics, materials, data treatment, textile etc.), because of commercial viability and public interests.[1], [2] E-textiles play a significant role in the European and U.S. textile sectors and can play an important role for the overall textile industry to become more competitive and in reshoring some of its activities in its transformation into a competitive knowledge-driven industry. These types of e-textiles combine knowledge from many disciplines with the specific requirements of textiles. Various materials and systems are available, as well as devices for sensing and actuation, but they are not compatible with a textile or with the textile production processes. Those materials could be transformed into a textile-compatible structure or even in a full textile structure.

Smart textiles can be defined as textiles that are able to sense and respond to changes in their environment and/or to perform a change in environment according to user requirements. They may be divided into two classes:

1) Passive smart textiles
2) Active smart textiles

Passive smart textiles can change their properties according to an environmental stimulation. This category includes shape memory materials with no electronic control devices, hydrophobic textiles, hydrophilic textiles, etc.

Active smart textiles are fitted with sensors and actuators to connect internal parameters to the transmitted message. They can detect different signals from the environment (temperature, light intensity, pollution, etc.) to decide how to react and finally to act using various textile-based systems or by being incorporated onto the textile substrates, flexible or miniaturized actuators (textile displays, micro-vibrating devices, light-emitting diode (LED), organic LED (OLED), etc.). The decision can be made locally in cases of embedded electronic devices (textile electronics) to smart textile structures or remotely when the smart textile is wirelessly connected to the cloud containing a database, servers with artificial intelligence software, etc., or when used as a part of the Internet of Things (IoT) concept.

Even if smart textiles and their subclass e-textiles gain a certain level of maturity, they are not yet ready for the market at large scale. The main issues for this are related to problems with reliability and the difficulties with laundering e-textile structures. Specific to reliability, e-textile structures should be in good functioning condition over a period of at least several years, if used in accordance with product guidelines. However, issues related to integration, connectorization and overall supply chain integration are also very important and should not be neglected.

This white paper emphasizes all these problems, encompassing efforts that industry and research laboratories must undertake to make e-textile structures more robust and able to be cleaned or washed similar to everyday textile products in the