Wearable functional e-textiles based on flexible filament circuits

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The functionalisation of textiles with electronic capabilities presents diverse applications where the electronics provide health monitoring, diagnostic and treatment platforms to the wearer [1]. However, the integration methods for incorporating such electronics into the textile in the research and commercial domains often compromise the natural characteristics and end-of-use recyclability of the textile [2], and more importantly the susceptibility of the wearer where the integrated electronics remain visible to the environment.

This paper introduces a platform technology in the EPSRC funded project - Novel manufacturing methods for functional electronic textiles (FETT) in figure 1, which combines standard microelectronic circuit fabrication and textile production techniques to hide modular electronics in bespoke pockets within textiles in the form 60 µm thick polyamide filament circuits [3]. The filament circuits are not visible after integration to the wearer or their environment. Unlike other integration methods where the textile is not detachable from the integrated circuits bonded to it mechanically or chemically, these filament circuits are loosely secured within the textile and are easily removable so as to enable end-of-use recycling of the textile and prevent electronic contamination.

The key novelty of the project is the patented vacuum forming packaging of its filaments before integration within the textile filed with application number PCT/GB2019/052906. The filaments are conformally encapsulated with a thermoplastic film which enhances durability of the filaments by situating the electronic layer on the neutral axis. Prototypes are shown to be reliable surviving more than 1500 bending cycles around a 90° bending angle and 50 washing cycles at 60 °C. Example demonstrator applications with this technology include accelerometer and temperature sensing e-textile circuits. Textiles with in-situ processing capability using miniaturised microcontrollers have also been demonstrated with digitally sequenced LED lighting patterns on the fabric.

References (optional)

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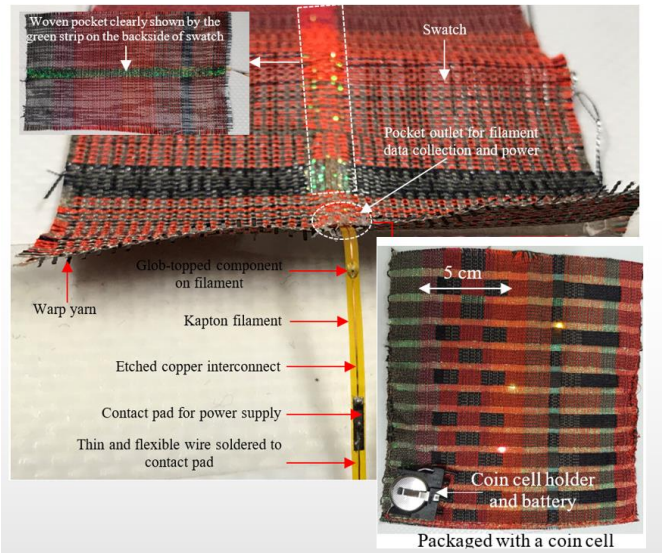

Figure 1. Integration of filament circuits in textiles