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Sustainability through Novel Materiality: Creating Three-Dimensional Electronics from Selvedge PLA

Currently the textiles industry produces large amounts of fabric waste by-products that are not easily recyclable or repurposed (Rissanen, 2005). A particularly pernicious type of waste is selvedge, which in its most entropic state consists of extremely short fibres that possess a dust-like texture and thus does not allow for the application of re-purposing processes such as felting or weaving. The recently concluded project “New process for Transforming unexploited Textiles into high value Products”, funded by the Textile Futures Forum, sought to address this problem, and has yielded an innovative material consisting of biodegradable PLA (Polylactic Acid) and selvedge. This novel material has unique tactile and functional properties that have yet to be fully explored. Its combination of a fabric-like surface and flexible plastic core indicate that there is great scope for using Selvedge PLA for wearable technology applications. The emerging research area of soft circuits (Buechley and Perner-Wilson, 2012; Mellis et al., 2013) within the field of e-textiles (Berzowska, 2005; Ryan, 2014), offers a particularly promising methodological approach for exploring the Selvedge PLA’s potential as a substrate for microelectronic components in conjunction with electrically conductive ink.

The proliferation of wearable electronics has created a demand for materials that can be harmoniously integrated into garments, interior fabrics or jewellery but also serve a functional purpose and adhere to high standards in terms of long-term sustainability. The research presented in this paper therefore proposes to explore the potential of Selvedge PLA to be used as a substrate for printed circuit boards and foldable electronics. Current materials and processes used for PCB manufacture are both environmentally unfriendly and do not exhibit tactile qualities that are desirable in a wearable technology context. Of particular importance for the presented project are the forays into foldable paper electronics suggested by Siegel et al. (2010), Tobjörk and Österbacka (2011) and Shorter et al. (2014) that propose a practice-based methodological approach which can be applied to working with Selvedge PLA.

The presented practical outcomes incorporate macerated cashmere and wool selvedge (Fig.1) within a semi-flexible PLA compound, and use the resulting Selvedge PLA sheet (Fig.2) and filament (Fig.3) to create pieces of interactive jewellery. This is achieved by printing electronic traces onto the Selvedge PLA sheet with conductive ink, and subsequently laser cutting and folding these into three-dimensional shapes. The folded shapes are then populated with other electronic components such as LEDs, microprocessors and sensors to create complete circuits. In conjunction with structural components 3D-printed from Selvedge PLA filament, these elements are used to create playfully interactive jewellery forms. Through the application of a research-through-making process, a novel methodological approach to materiality is encouraged that prioritises a deeper engagement with the concept of combining functionality, tactility and sustainability within aesthetically sophisticated objects belonging to the emerging discipline of interactive craft.