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# Enabling Smart Textiles

## High performance graphene-based inks designed for use on fabrics

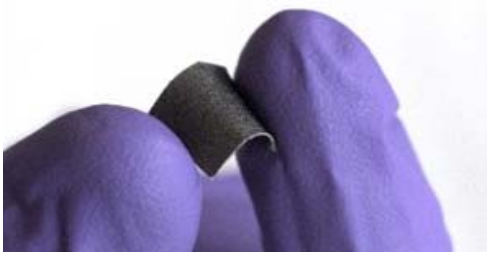
The use of graphene and other related 2D materials (GRMs) inks to create fabric-integrated electronic components and devices and innovative textiles is at the centre of new technical advances in the smart textile industry.

Present issues with GRM inks include poor adhesion of the ink to the substrate, poor connectivity across layers due to substrate roughness, unwanted absorption of carrier fluid by the fabric substrate leading to poor quality deposited layers, and poor durability and washability of the deposited inks.

Dr Tian Carey and Dr Felice Torrisi in the Department of Engineering, University of Cambridge have developed a method to address such issues and improve the quality and performance of GRM ink layers deposited on fabrics and textiles.

This enables a number of exciting commercial opportunities for GRM inks in areas such as:

- Functional garments
- High-performance sportswear
- Personal health technology
- Wearable technology/computing
- Fashion – conductive interconnects
- Automotive Industry – heating elements, sensors
- Protection – flame retardants, waterproofing



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## Background

Graphene and related materials (GRMs) have unique mechanical, electrical and optical properties. In many cases they also have exceptional environmental stability (low moisture absorption) and potential for low-cost production enabling fully flexible printed flexible electronics and photonics.

This places GRMs as prime candidates to play a major role in the wearable electronics and smart textiles sectors, where classical cotton, silk, and other natural or synthetic fabrics can be transformed into advanced active textiles exhibiting electrical, optical and/or smart thermal functions.

## Technology

Several techniques have been developed to modify and prepare fabric substrates to improve the quality and performance of deposited GRM ink layers.

For example the application of a smoothing or planarization layer (such as by bar coating or screen printing) can be used to decrease the roughness of the fabric substrate.

GRM inks can then be deposited and layered using a combination of ink deposition methods (e.g. inkjet, flexographic, gravure, spray coating, rod coating, roll to roll coating, slot-dye coating, spin coating, dip coating and screen printing) to produce flexible electronic components or devices.

A polymer overlay can also be applied to provide final protection to the GRM ink-based electric component to preserve its electrical, optical and mechanical properties.

## Commercialisation

This technology is protected by a PCT patent application and is currently being commercialised by Textile Two Dimensional Ltd, a spin-out of the University of Cambridge. Textile Two Dimensional is now looking for commercial partners who are interested in adding functionality to their textile product. These may be enhancements to existing applications or completely new opportunities enabled by this exciting technology.

If you are interested in exploring how your company can work with us, please contact us using the details on the front of this sheet or alternatively contact Textile Two Dimensional Ltd through their website www.textile2dimensional.com

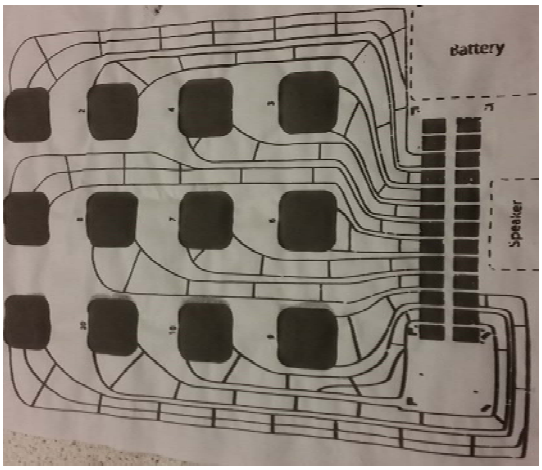


**Figure 1:** A micrograph of screen printed conductive graphene interconnects on cotton fabric to create a touch sensitive fabric

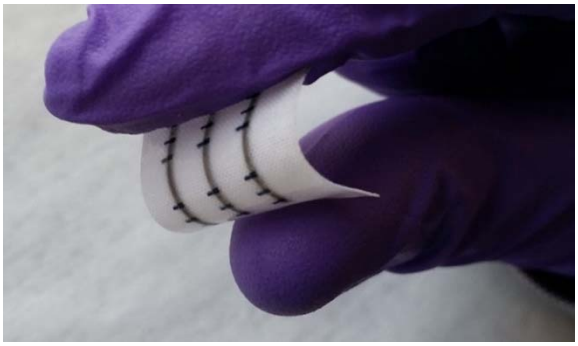

**Figure 2:** Fully inkjet printed thin film transistors using 2D materials during flexing

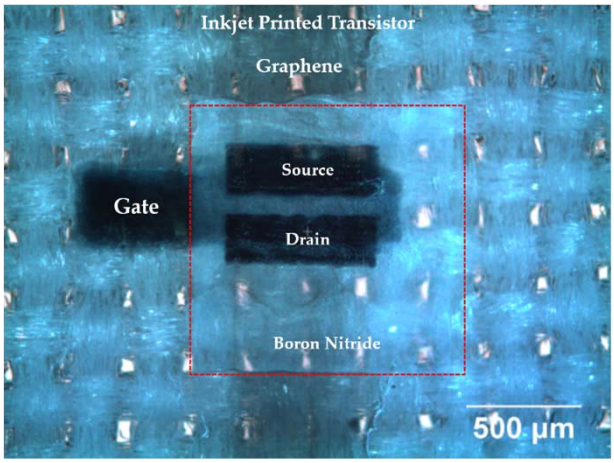


**Figure 3:** Optical image of fully printed transistors on textile which are washable, flexible, biocompatible and environmentally sustainable