Graphene-coated transparent conducting fibres for smart textiles

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Abstract The development of electronic textiles is one of the hottest topics in organic electronics. There are already examples of smart textiles in garments for monitoring physiological and biomechanical signals. However, the manufacturing schemes for current applications rely mostly on the integration of off-the-shelf electronic components mounted on a textile substrate. Such components are silicon-based, thus unsuitable for applications where flexibility and fault-tolerance are required. Organic electronics is an alternative to conventional silicon technology and can overcome those limitations. In this sense, graphene, with high optical transparency and electrical conductivity, is a promising material.
In the pursuit of conducting fibres, our approach consisted in coating specially designed nanosmooth polypropylene fibres with graphene. Monolayer graphene was grown on copper foils by low pressure chemical vapour deposition using methane as a carbon source, and wet-transferred to the fibres after copper etching. Graphene adhesion to the fibres was found to be sensitive to minute surface modifications. In that sense, several surface treatments were tested and AFM microscopy was performed to evaluate the resulting changes in the surface of the fibres. Raman spectroscopy confirmed the presence and quality of the graphene transferred onto the fibres, and optical measurements proved that the fibres remained transparent after the graphene coating. The I-V response of the fibres was measured with different curvatures, and the corresponding sheet resistance was found to be of the same order than monolayer graphene on conventional silicon substrates, up to 10^4 Ω/sq. Besides polypropylene, the study was successfully extended to Nylon commercial fibres.

Figures

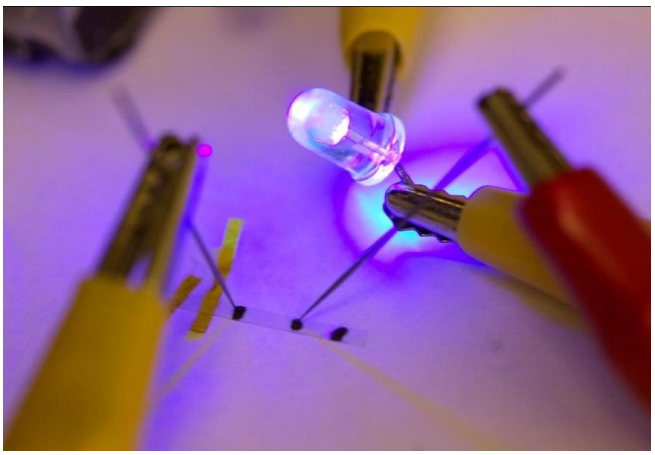

Fig. 1. Graphene-coated polypropylene fire closing an electric circuit that is powering a LED (graphite was applied to define the channel area).