Liquid and gas phase deposition of graphene on technical fabrics: process development and study of chemical and physical properties

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Technical fabrics have already conquered various industrial sectors, from clothing to cars, aeronautics and medicine. One of the challenges in this field is to improve the performances of the fabrics in terms of user's comfort and safety. For instance, the ability of textiles to dissipate heat or to get stealth properties is nowadays of high interest for different application fields. Graphene, a two-dimensional light and resistant carbon structure, is a material combining high electrical and thermal conduction that can be associated to technical fabrics in order to get the physical properties required.

In this context, our objective is to develop suitable processes to deposit graphene-like layers on the surface of the fabrics to obtain electrical and thermal conducting technical textiles. Two routes are envisaged. The chemical route consists of coating the fabrics with a suspension containing graphene-like nanoplatelets. The gaseous route consists of growing graphene films by CVD directly on the fabrics. Various works in the literature report studies on the liquid coating of tissues with graphene-like platelets. However, the levels of electrical and thermal conductivity are still quite low and disparate whatever the types of graphene and coating technologies used [1]. Regarding the gaseous route, the growth of graphene usually requires a synthesis temperature between 800°C and 1000°C. However, the fabrics concerned in this project are composed of thermostable fibres and are mainly synthetic fibres that are only stable in the [350-500]°C temperature range. Therefore, the synthesis temperature must be lowered, and recent studies have shown that it is possible to synthesize graphene at such temperature range, but most of the studies have been performed on flat substrates [2-3].

In this communication, we will present our results regarding, first, the liquid route. We investigated, on flat substrates, the electrical percolation thresholds as a function of the graphene concentration and additives concentration. To improve the level of electrical conductivity, we have chosen to add additional conductive components like conductive polymer. Subsequently, the deposition process was transferred onto technical fabrics and the electrical conductivity of textile substrates was studied after the deposition of the graphene-like suspension resulting from different commercial graphene-like platelets. We obtained, following the IEC 93:1980 standard, a surface resistivity less than 3 kΩ/sq which is better than what is reported in most of the other studies [1]. However, the comparison must be considered with caution as the resistance measurement depends on the method of characterisation used. For the gaseous route, the first tests were conducted on bulk Ni substrates for easier characterisation. We succeeded to synthesize a graphene-like structure at 500°C with a gaseous carbon precursor. Further work is in progress to improve the quality and homogeneity of the deposited material.

References

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