Flexible and electrically conductive polymeric composites for wearable electronics

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Electrospinning of fibers from solution (Figure 1) is the most studied method to produce polymeric nanofibers, because it offers a good compromise between morphology control and scalability. Several polymers can be electrospun obtaining lightweight, flexible textile mats composed by randomly-oriented or aligned nanofibers with nanometric (< 100 nm) or sub-micrometric (from 100 to 500 nm) diameters.

Nanosheets made of Graphene correlated materials can have a lateral size comparable to the nanofiber dimensions, and are an interesting filler for the production of polymeric composites. Electrospun GRMs composites possess enhanced mechanical properties[1] and their nanofibrous morphology confers them a high surface-to-volume ratio, which can lead to a faster response to external stimuli[2]. Nonetheless, the choice of an appropriate technique for the production of the polymeric composite is crucial for the improvement of the electrical conductivity of the material.

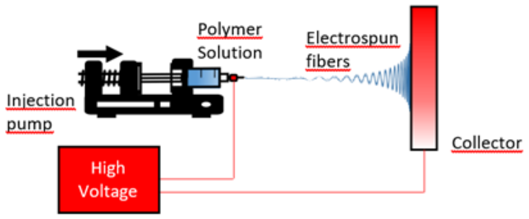
In this research activity, we study and optimize the electrospinning of PA6 nanofibrous mats to obtain nanofibers with a controlled diameter in the 300-500 nm range. Previous work[3] showed that co-electrospinning hinders the possibility to obtain electrically conductive GRM-based composites. For this reason, we produced novel materials by coating pristine polymer mats with GO exploiting a sonication-assisted dip coating technique. These coated composites were afterwards reduced both chemically, using Vitamin C, and thermally.

Characterization of these materials confirmed the effectiveness of the electrospinning and coating processes (Figure 2). Electrospun composites showed considerable electrical properties while preserving the mechanical flexibility and the surface morphology conferred by the electrospinning process. Thanks to these unique features, these materials are interesting for wearable electronics and smart textiles, as they can be exploited in different applications (e.g. sensors).

References

[1] Panzavolta et al, Carbon, 78, 566-577, (2014)
[2] Reddy et al, Polymers, 13, 3746, (2021)
[3] Gasparini et al., Graphene Technology, 5, 49–57, (2020)

Figures



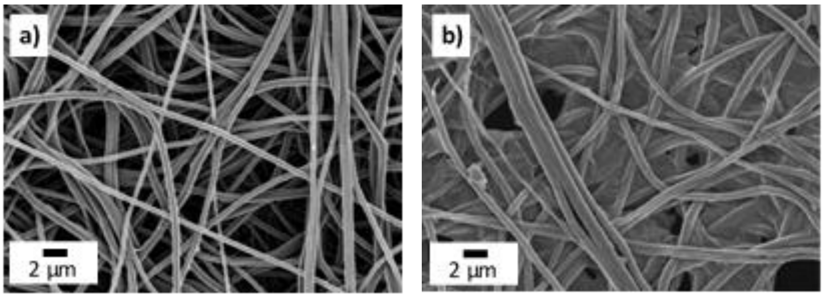


Figure 1: Electrospinning setup schematization

Figure 2: SEM images of pristine electrospun PA6 (a) and rGO-coated PA6 composite (b)