MULTIFUNCTIONAL FIBROUS STRUCTURES BASED ON GRAPHENE NANOPLATELETS, CHITOSAN AND NATURAL FIBRES

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ABSTRACT

1. Background and Objectives

In recent years, graphene has received special attention due to its extraordinary properties, including mechanical strength, electrical and thermal conductivity, UV-protection, hydrophobicity, antibacterial activity, degradation of harmful agents and lightweight 1. Therefore, graphene-textile systems could be used for wearable technologies, personal protection systems, mechanically reinforced composites and chemical/biological protection agents. These fibrous based systems are very promising solutions for several fields including sports, healthcare, automotive industry, military protection, aerospace engineering, etc 2.
However, pure graphene is still very expensive and is not yet produced in high quantity. In this way, graphene nanoplatelets (GnPs) arise as a valuable, low cost and industrial scalable alternative. With the environmental consciousness growing, the sustainable materials are acquiring extremely importance. In this way, the use of bio-based polymers such as chitosan and flax fabrics is preferable over the synthetic ones due to its biodegradability, low-cost and lightweight. Therefore, these green materials can be used as a valuable alternative to develop fibrous based systems with multifunctional properties using GnPs 34.

2. Methods

In this work, chitosan was used for the dispersion of several graphene nanoplatelets percentages (0.1, 0.5, 1 and 2%). Several parameters were optimized, and the dispersions were used for flax fabrics impregnation using the dip-pad-dry method, solvent casting or compress moulding. All the samples were characterized by FESEM, ATR-FTIR, Raman, and XRD. Several properties were analysed including: electrical conductivity, piezoresistive response, thermal conductivity, UV protection, mechanical properties, antibacterial activity, degradation of chemical agents, hydrophobicity and durability/washability.

3. Results

The incorporation of GNPs was successful onto the flax fibres as the FESEM analysis showed. The presence of GNPs onto the flax was visible in all the percentages of GnPs under study and the dispersion appeared to be uniform. The samples exhibited electrical conductivity values ranging from ~ 3×10-4 S/m (0.1%GnPs) to 0.8 S/m (2% GnPs). The pressure sensing properties of the fabrics was quantified by the gauge factor, values from 1.6 to 1.8 were obtained. The mechanical properties of the developed systems improved when compared with the nonfunctionalized fabrics as well as the thermal conductivity. The antibacterial tests revealed that these systems present antibacterial activity by contact determined by the halo method using gram-positive and gram-negative bacteria cultures

4. Conclusions

Overall this work demonstrates the potential of using GnPs for the development of multifunctional fibrous structures with special application in the smart textiles area.

5. References

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