Graphene and graphite chemical modifications to perform electrical conductive polymer nanocomposites

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Abstract:
The last decade, graphene attracted much attention thanks to its 2D structure, high aspect ratio and high surface area. These intrinsic properties made it one of the most promising filler for the development of high added-value polymer nanocomposites [1], [2]. However, graphene nanoparticles are difficult to disperse in polymer matrices. Chemical modification is one of the solutions to improve the dispersion of graphene in polymers. The aim of our study is to tune the chemical modification to improve graphene or graphite dispersion while achieving a high electrical conductive polymer nanocomposite.
The chemical modification used is a versatile method based on « grafting onto » functionalization with a previously synthesized copolymer. This functionalization is performed in several steps: (1) oxidation via Hummers or nitric acid attack, (2) "grafting onto" of a copolymer (P(MMA-co-HEMA)) and (3) reduction to recover the high electrical conductivity. The present study is focusing on the characterization of the graphene and graphite chemical modification. Raman spectroscopy reveals high defect concentration due to the strong oxidation and formation of sp^3 bonds. XRD allows to show the structure modification (intercalation or exfoliation of the platelets). AFM and SEM allowed to show the exfoliation and the reduction can be quantify by coupling EDX with SEM. TGA, FTIR and Py-GC/MS characterizations proves the chemical modification and the amount of grafted copolymer. Finally, electrical measurements on powders were carried out to determine the impact of chemical modifications on electrical properties.

References

[1] D. G. Papageorgiou, I. A. Kinloch, and R. J. Young, "Mechanical properties of graphene and graphene-based nanocomposites", *Prog. Mater. Sci.*, vol. 90, pp. 75–127, 2017
[2] Marsden, A. J Papageorgiou, D. G.Vallés, C.Liscio, A.Palermo, V.Bissett, M. A.Young, R. J.Kinloch, "Electrical percolation in graphene-polymer composites", 2D Materials, vol. 5, pp 1-19, 2018

Figures

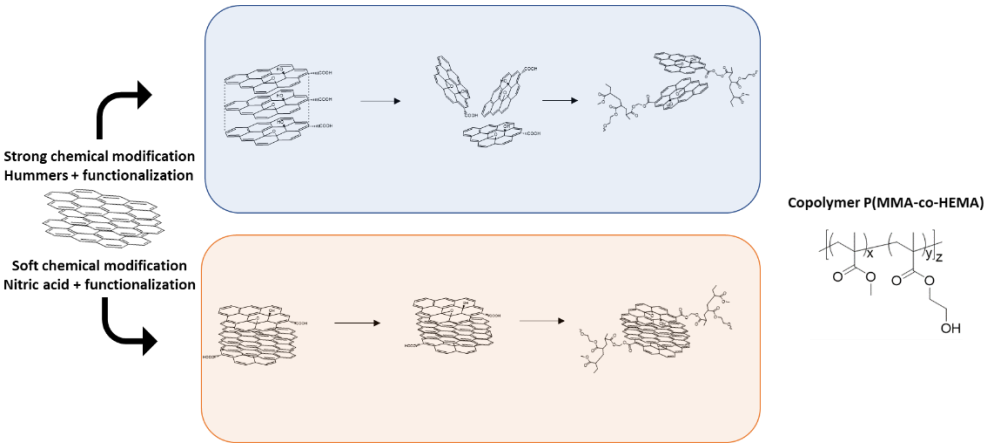

Figure 1: Chemical modifications strategies