Development of industrial polyolefin-carbon nanotubes nanocompounds : associated scientific challenges

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Since the paper [1] from Sumio Lijima (NEC) in 1991, carbon nanotubes (CNT) have attracted a lot of interest. In the nineteenths and beginning of the 20th century, many academic papers have been published, describing (i) synthesis route and intrinsic properties of CNT but also (ii) blending approaches of CNT into polymer matrix and associated properties. Such incorporation of CNT into a polymer matrix is of course motivated by the difficulties to process pure CNT.

Despite all these publications, highlighting a huge potential, there are very few large volume industrial applications using blends of CNT into a polymer matrix, especially when the considered matrix is a polyolefin like polyethylene, polypropylene or polystyrene.

The first main challenge is to manage the CNT dispersion into the polymer matrix in a robust and efficient way. This is particularly a challenge in nonpolar polymers.

The presentation will be mainly focused on the second main challenge, which is related to the processing of polymers filled with CNT. When processed, the molten nanocomposite could undergo important shear and/or elongation effects. The CNT network is modified during the material deformation, implying a shift in the overall conductivity [2]. Specific rheological tools have been developed to perform an in-depth study of the concerned physico-chemical mechanisms.

Thanks to the performed studies, appropriate processing conditions and/or post-treatments were identified, providing electrical percolation with a quite low CNT content even when severe processing conditions are considered. This supports the industrial use of these compounds in more and more applications like electro-dissipating (ESD) packaging, EXplosive ATmosphere (ATEX) devices, …

References

[1] Sumio Iijima, *Nature* **354** (1991) 56.
[2] Abbasi, S., Carreau, P. J. and Derdouri, A., Polymer **51** (2010) 922.