

# FUNCTIONALIZATION OF CARBON NANOTUBES VIA PLASMA POST-DISCHARGE SURFACE TREATMENT: IMPLICATION AS NANOFILLER IN POLYMERIC MATRICES

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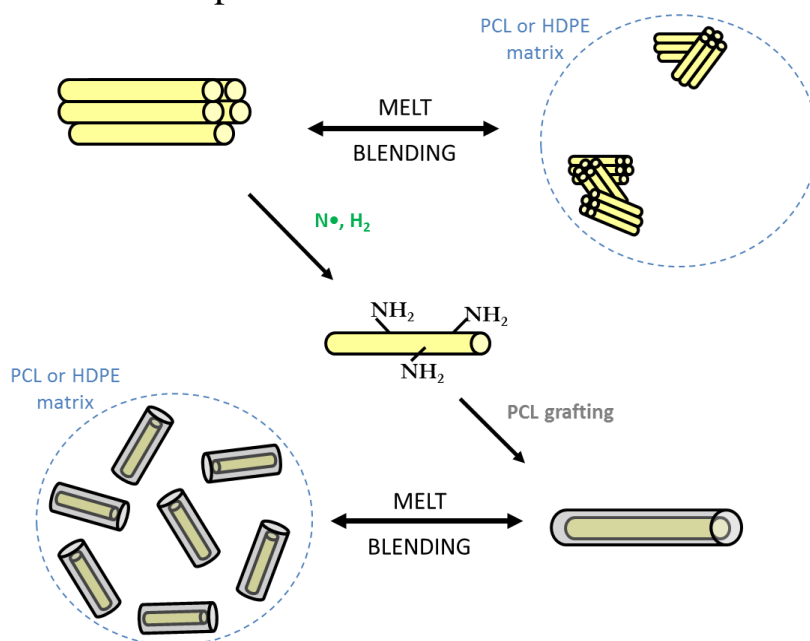
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In the early 90's, the incorporation of carbon nanotubes (CNTs) in polymeric matrices was envisaged to improve the mechanical and thermal properties of polymers<sup>1</sup>. Due to their high electrical conductivity and high aspect ratio, CNTs can also percolate to form a conductive network in insulating matrices at low loading (1-3 wt%)<sup>2</sup>. The properties of the CNT-filled nanocomposite depend on several factors such as the polymer nature, the amount of impurities on CNTs and the dimensions of CNTs (aspect ratio). However, two key-factors remain the CNT dispersion quality and the interfacial interactions between CNTs and host matrix. Among the different proposed strategies to improve the CNT dispersion ability, the covalent functionalization has showed its potential for pre-disaggregation of CNT bundles that is the first step to achieve a good dispersion of CNTs<sup>3</sup>.

In this study, CNTs were functionalized via an original covalent surface treatment that consists of exposing the CNTs to a reactive flow of atomic nitrogen<sup>4,5</sup>. The so-grafted primary amine groups were used as initiating sites for lactone polymerization forming CNT-g-polyester nanohybrids allowing the pre-destruction of the CNT agglomerates. The CNT-based nanocomposites have been prepared by the melt blending of polymers with nanohybrids, used as highly filled chemical masterbatches, and their thermal, electrical and morphological properties have been characterized.

The amine grafting appeared to occur mainly at defects on the surface of CNTs, limiting any damages on the carbon nanotubes structure, and more likely preserving their physical properties such as electrical conductivity<sup>6</sup>. The investigation of two different polymer matrices, i.e. PCL (same nature than polyester-coating at the surface of the nanotubes) and HDPE, known

for its non-compatibility with PCL chains, allowed to determine the influence of the CNT-polyester coating on the resulting electrical properties of the nanocomposites<sup>7</sup>.



Schematic representation of the used strategy to disperse CNTs in polymer matrices.

The HDPE filled with PCL-coated CNT nanohybrids showed better electrical properties than HDPE filled with non-modified CNTs. The electrical properties improvement was associated to a better dispersion of the fillers and, also, to the exclusive presence of PCL coating in tunnelling junction between the CNTs. Moreover, the influence of CNTs on the semi-crystalline framework of the PCL composite was studied more in depth<sup>8,9</sup> and compared with those achieved with other nano-sized filler particles<sup>10</sup>.

## References

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