

Functionalization of vertically aligned carbon nanotubes: low-kinetic energy oxygen ion irradiation

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Carbon nanotubes (CNTs) are nanostructured material with high technological importance. To tailor the CNTs applicability their properties can be altered through changes of their surface chemistry by functionalization. For example, the CNT surface functionalization with oxygen groups can enhance their surface chemical reactivity and change their hydrophobicity. Moreover, oxygen groups can act as active sites for further functionalization increasing their potential applications in different fields, such as drug delivery, bio imaging, water purification, catalysis, among others [1].

In order to obtain an optimal tailoring of the CNTs chemical and electronic properties, the functionalization technique used must be well-controlled. Within this perspective, we use low-kinetic energy oxygen ion irradiation (up to 2 keV), to functionalize the surface of vertically aligned CNTs. X-ray photoelectron spectroscopy (XPS) analysis indicates that oxygen ion irradiation produces three different types of oxygen functional groups at the CNTs surface: epoxy, carbonyl and carboxyl groups. Density functional calculations suggest assignment of XPS C 1s peaks at 286.6 and 287.5 eV, to epoxy and carbonyl functional groups, respectively [2]. The relative concentration of these groups depends on the parameters used for the oxygen ion irradiation. Scanning electron microscopy (SEM) shows that the macroscopic structure and alignment of v-CNTs are not affected by the ion irradiation. We observed that in comparison to oxygen plasma treatment, oxygen ion irradiation shows higher functionalization efficiency. Ion irradiation leads to higher amount of oxygen grafting at the v-CNTs surface, besides different functional groups and their relative concentration can be tuned varying the irradiation parameters.

References

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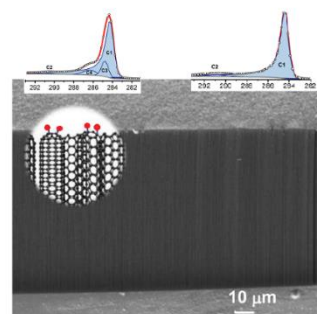


Figure 1. Representation of oxygen functionalization of vertically aligned carbon nanotubes. The insets show the C1s XPS peak recorded before and after oxygen ion irradiation.