Anisotropy effects on ion-bombarded highly aligned Carbon Nanotubes

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Carbon Nano Tubes (CNTs) have been the focus of considerable research since their discovery [1]. Their intrinsic structural anisotropy, associated to their high aspect ratio (length/diameter), results in a quasi-continuous wave vector along the nanotube axis and discrete wave vectors in the circumferential direction, yielding anisotropy to electrical, optical and magnetic properties. Aligned CNTs have been recently suggested as potential devices for the dark matter Weakly Interacting Massive Particles (WIMPs) detection [2-3], by exploiting their anisotropy. Thus, this one-dimensional (1D) system also suggests the importance of researching the anisotropic effect under directional ion bombardment, mimicking the effect of WIMP interaction with C atoms. Furthermore, thanks to the high surface/volume ratio, CNT are a potential platform for alkali metal uptake [4], which could be enhanced by the deliberate introduction of controlled defects in their structure. In this work, we present a throughout study of the anisotropy response of highlyaligned CNTs under controlled Ar+ ion-bombardment, as a function of dose and energy, by combining complementary microscopy (Scanning Electron Microscopy, SEM) and spectroscopy (Raman and X-ray Photoelectron Spectroscopy, XPS) techniques. SEM images show the change in CNT morphology, while the XPS chemical and surface sensitivity allows to identify the defect-induced fingerprints at the C 1s lineshape, and Raman spectroscopy unveils defect-induced bond distortions and amorphization. A clear anisotropic behaviour is brought to light upon ion-bombarding either on-top or laterally the highly-oriented CNT "brush", thus paving the way towards their potential application as devices.

[1] S. Iijima, Nature 354, 56 (1991) [2] L.M. Capparelli et al., Phys. Dark Univ. 9–10, 24 (2015) [3] G. Cavoto et al., Eur. Phys. J. C 76, 349 (2016) [4] de las Casas and Li, J. Power Sources 208, 74 (2012)b