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Investigation of carbon nanotubes surface functionalization through Raman and XPS analysis

Alberto Tagliaferro¹, Mauro Giorcelli¹, Aikaterini-Flora Trompeta² and Costas A Charitidis²¹Polytechnic University of Turin, Italy²National Technical University of Athens, Greece

Currently, the most common way to incorporate carbon nanotubes (CNTs) in polymer matrices, is to functionalize their surface by adding oxygen containing groups. The chemical process that is followed in such occasions, includes strong acids, such as sulfuric (H₂SO₄) and nitric (HNO₃) acid, together with temperatures up to the boiling point of the acids. Moreover, the chemical functionalization procedure can last up to three days, including both the reaction step and the purification that follows after. For this reason and considering the environmental impacts of such a procedure, it is important to investigate the preferable conditions for the functionalization, studying the aforementioned parameters and trying to eliminate the energy, reagents and time consumption. In this framework, an investigation on the chemical functionalization of CNTs has been performed, utilizing X-Ray Photoelectron Spectroscopy (XPS) analysis for the quantification of the oxygen groups attached on the surface of CNTs in each trial, supported by RAMAN spectroscopy that confirmed the preservation of the structural integrity of CNTs, after the treatment. CNTs were prepared via the Catalytic Thermal Chemical Vapor Deposition (CT-CVD) method, using two different catalysts (based on Fe and Co/Mn particles) synthesized in house, in order to investigate also the effect of the structural properties of CNTs in the chemical functionalization effectiveness. A parametric

study was carried out, considering the acids concentration, the reaction time and temperature, as well as the CNTs/acid mass/volume ratio. The results revealed that CNTs that have been grown through the Co/Mn catalyst, present smaller diameters and narrow diameter distribution, thus they are more vulnerable to the acidic chemical functionalization in comparison with the CNTs grown on the Fe particles and as a result they can be treated in milder conditions, offering a "greener" chemistry pathway.

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Biography

Dr. Alberto Tagliaferro is Associate Professor in Solid State Physics at Politecnico Torino. His research activity is mainly on carbon nano and micro-structured materials, with particular focus on those from green sources. Raman characterization of such materials and their application in composites, sensors and energy are the main subjects of his current activity. He has published more than 160 papers in International Journals and is Associate Editor for BioNanoScience (Springer).

alberto.tagliaferro@polito.it