Synthesis and characterization of N-doped MWCNTs by CCVD using a biphasic substrate: $Ni/La_2Z_2O_7$

In this work we report a synthesis of nitrogen doped multiwall carbon nanotubes (N-MWCNTs) using a nickel biphasic catalyst. The catalyst phase segregation during calcination allows us to obtain a well dispersed and nanometric-sized NiO particles over a $La_2Zr_2O_7$ support that helps to prevent the former to coalesce and sinter by a suitable support-catalyst interaction. The catalyst was prepared by co-precipitation of the salts and calcinated at 900 °C. The synthesis of N-MWCNTs was carried out with catalytic chemical vapor deposition (CCVD) method using benzylamine as precursor at four different temperatures (800 °C, 850 °C, 900 °C and 950 °C) during 30 minutes under $Ar:H_2$ flow of 2.5 $Lmin^{-1}$. The X-ray diffractogram verifies the phase separation of NiO and $La_2Zr_2O_7$ as well as the formation of metallic Ni after the synthesis. The HRTEM (high-resolution transmission electron microscopy) images show bamboo-shaped multiwall carbon nanotubes. The deconvolution of the Raman spectra identifies I, D, D** and G peaks, that can be associated with the incorporation of N, sp^2 network defects, C-C stretching and staking imperfections, respectively. The thermogravimetric analysis (TGA) performed in air gives a higher oxidation temperature for N-MWCNTs obtained at 900 °C and 950 °C which is probably due to the higher graphitization, or less presence of defects promoted by the higher temperatures. Future analysis will determine the application potential of the samples.