

Carbon Nanotube-Fe/Al₂O₃ Nanocomposites by CCVD Method: Formation of CNTs from α -(Al_{1-x}Fe_x)₂O₃ Oxide Powders that were Prepared by Oxinate Route

Valdirene G. de Resende¹, Eddy De Grave¹, Anne Cordier², Christophe Laurent², Alain Peigney² and Alicia Weibel²

¹Department of Subatomic and Radiation Physics, University of Ghent, B-9000 Gent, Belgium
Email: valdirene.gonzaga@ugent.be

²CIRIMAT, CNRS/UPS/INPT, LCMIE, Université Paul-Sabatier, Bât. 2R1, 118 route de Narbonne, 31062 Toulouse cedex 9, France

In this contribution the formation of carbon nanotubes from α -(Al_{1-x}Fe_x)₂O₃ oxide powders containing different amounts of iron is examined. These oxide powders were prepared by combustion of oxinates and characterized in detail in an earlier report. Three different ways of growing CNTs were applied: (i) from the starting solid solutions, α -(Al_{1-x}Fe_x)₂O₃; (ii) from a self-supported solid-solution foam; and (iii) from a self-supported solid-solution foam and using a commercial ceramic foam impregnated by Mo₂O₃. Upon reduction during heating at 5 °C/min up to 1025 °C in H₂/CH₄ of the oxide powders nanometric Fe particles, which are thought to be active for the in-situ nucleation and growth of carbon nanotubes, are formed. The post-reaction phases as identified by Mössbauer spectroscopy (Fig. 1) are α -Fe, Fe₃C, γ -Fe-C, α -(Al,Fe)₂O₃, Fe_{1-y}C_y alloy and Fe²⁺-bearing phase. These two last components are not present in all of the spectra of the CNT-nanocomposite samples. The most important aspect of this series of experiments was that, for each of the applied synthesis routes, almost no undesirable carbon forms were detected in the nanocomposite powders obtained from oxide solid solutions containing more than 2 cat.% Fe. In addition to Mössbauer spectroscopy, the powders were characterized by X-ray diffraction, Raman spectroscopy, carbon analysis and electron microscopy.

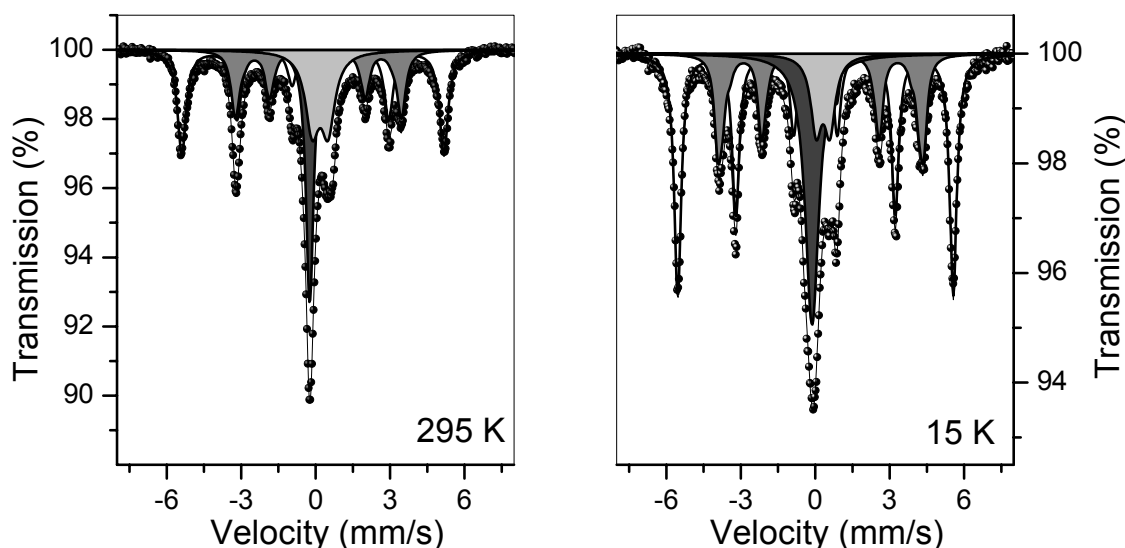


Fig. 1: Typical Mössbauer spectra of the CNTs-Fe/Al₂O₃ nanocomposite powders measured at 295 K and 15 K. α -Fe (white); Fe₃C (gray); γ -Fe-C (dark gray); and α -(Al,Fe)₂O₃ doublet (light gray).