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Study by SEM of Carbon Nanotubes Deposited by CVD Using Al_2O_3 and TiO_2 as Catalysts

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The design and manufacture of nanomaterials for the application of nanotechnologies have allowed establishing different methods for the development of carbon nanotubes (CNTs) using a variety of precursors, this has increased the aerospace, biomedical and electronic applications, to name a few. The precursors used include transition metals cobalt (Co), iron (Fe), Al_2O_3 and TiO_2 [1]. The objective of this work is to compare the Al_2O_3 and TiO_2 used as catalysts for the production of carbon nanotubes by the CVD method. In both cases the methodology was the same, the elements were mixed in an agate mortar to mix them for 10 minutes, then they were poured into an alumina crucible to sinter them at 600ºC in an air atmosphere to be calcined, introducing them into a tube of quartz 4 inches (101.6 mm) in diameter by 39.37 inches (0.0393 mm) long. When the catalysts were obtained, they were poured in another crucible to sinter in an Argon inert atmosphere at 730ºC for 11 minutes with a constant flow of 500 L/min, then ethylene was supplied at 300 L/min both gases for 30 minutes, after the time the valve of C_2H_4 is closed, lowering the Argon supply to a flow of 300 L/min for 120 minutes upon reaching 25°C. [2], [3]. The nanotubes were dispersed in a beaker with 20 ml of isopropanol by ultrasound for 9 minutes. To verify the formation of carbon nanotubes (CNT's), Scanning Electron Microscopy (SEM) was performed, at magnifications of 40000x and 100000x. In Figure 1a, the CNTs with Al_2O_3 can be observed with diameters in a range of 46-65 nm. A considerable amount was also present with a successful dispersion having a diameter greater than that of TiO_2. In Figure 2a with a magnitude of 40000x, the CNTs with TiO_2 show a morphology with agglomeration of the catalyst, which does not allow to measurement of the diameter of the nanotubes. In Figure 2b with magnification at 100000x, the carbon nanotube is measured at 40.73 nm. The CNTs made with both Al_2O_3 and TiO_2 as catalyst show uniform structures, with very similar diameters and filaments. They presented agglomerations; and the length of the nanotubes could not be evaluated because the dispersion was performed for a short time. The Al_2O_3 catalyst is a better catalyst for the manufacture of carbon nanotubes.

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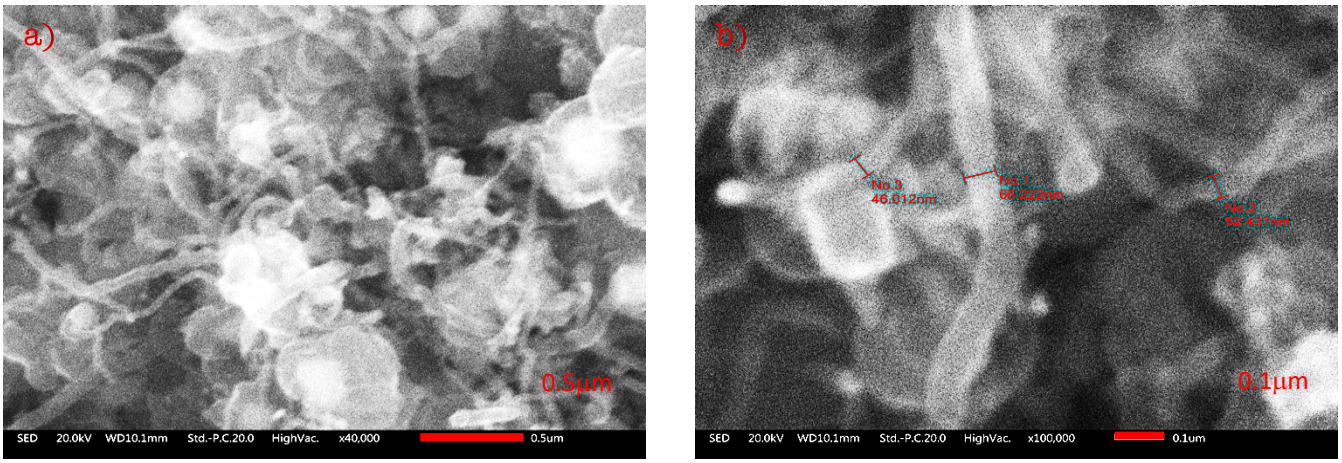

Figure 1. SEM micrographs of carbon nanotubes with Al_2O_3 as catalysts.

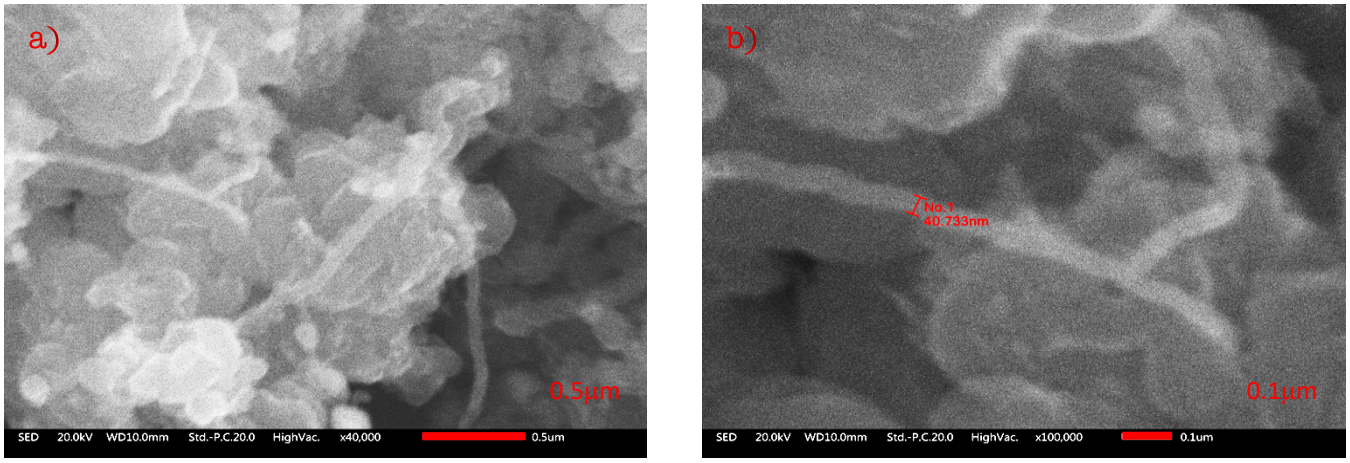

Figure 2. SEM micrographs of carbon nanotubes with TiO_2 as catalysts.

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