

Analysis of Raman Spectroscopy and SEM of Carbon Nanotubes Obtain by CVD

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Currently, carbon nanotubes are widely used with different precursors, methods for different applications causing a boom in metal alloys for biomedical applications. [1-2] The objective of this work is to verify if the titanium of high purity and titanium at 600°C treated thermally, can be used as catalysts to obtain carbon nanotubes by the CVD method. We use as a catalyst the cobalt and iron, for both cases Ti high purity and Ti at 600°C, placed in an agate mortar for mixing and then in an alumina crucible to catalyze at 600°C, then it is placed in a tube of quartz of 4 inches Ø (101.6 mm) by 39.37 inches (0.0393 mm). The oven to use model. TFM2-1200, in which 500 L/min of Ar is supplied for 11 minutes at a temperature of 730°C, which is maintained for 30 minutes, with a flow of 100 L/min of ethylene and 500 L/min of Ar Subsequently the supply of C₂H₄ is closed and the Ar is lowered to 300 L/min for 120 minutes until reaching 25°C. Raman spectroscopy performed in an Invia Reflex Raman Microscope (RENISHAW) with Resonsac 785nm laser diode, Ion Ar 514nm laser, a resolution obtained approximately 1cm⁻¹; to verify the possible existence of obtaining carbon nanotubes by means of the CVD method. Raman spectroscopy. It establishes a range of tangential mode G around 1590 cm⁻¹ which were used to identify the presence of carbon ordered as graphite and carbon nanotubes, having hybridized the carbon system. The D band around 1350 cm⁻¹ is associated with defects or amorphous carbon, giving an indication of the amount of disordered carbon. Therefore, the ratio of the D/G band intensities is used as a qualitative measurement for the formation of unwanted forms of carbon [3-5]. Figure 1. Presents the following peaks indicating the presence of carbon nanotubes, (a) 1344.82cm⁻¹, 997.71u.a. (b) 1588.35cm⁻¹, 358.97u.a. (c) 1341.98cm⁻¹, 587.66u.a. (d) 1581.23cm⁻¹, 819.48u.a. In the spectroscopy (B) figure 1 of the Ti at 600°C presents the following peaks (e) 1349.47cm⁻¹ 189.29u.a. (f) 1586.16cm⁻¹, 198.18u.a. (g) 1343.79cm⁻¹, 302.44u.a. (h) 1578.74cm⁻¹, 369.26u.a. resulting carbon nanotubes. The micrographs realized with (SEM) Electronic Scanning Microscope model EVO MA 10. The morphology showing agglomeration with different diameters and lengths was observed presenting a complex length measurement, for Ti at 600°C figure 2 (a) and (b). In figures (c) and (d) although there is agglomeration, a better result can be obtained with Ti of high purity, to obtain carbon nanotubes. In conclusion, we can say those metallic elements are proposed to sinter carbon nanotubes by the CVD method. Which offers a simple, innovative and effective procedure.

References:

- [1] Jong-Hee Park, "Chemical Vapor Deposition", Scarborough, ON, Canada p. 1-22, 2001.
- [2] Wesley F. Oliveira, Isabel R.S. Arruda, Germana M.M. Silva, Materials Science & Engineering C **81** (2017), p. 597.
- [3] Dresselhaus, M. S. *et al*, Contemporary Concepts of Condensed Matter Science **3** (2008), p. 83.

[4] Bachilo, S. M. *et al*, Science, **298(5602)** (2002), p. 2361.

[5] Bergstrom Jr, R., & Knoesel, E., Bulletin of the American Physical Society, **52** (2007).

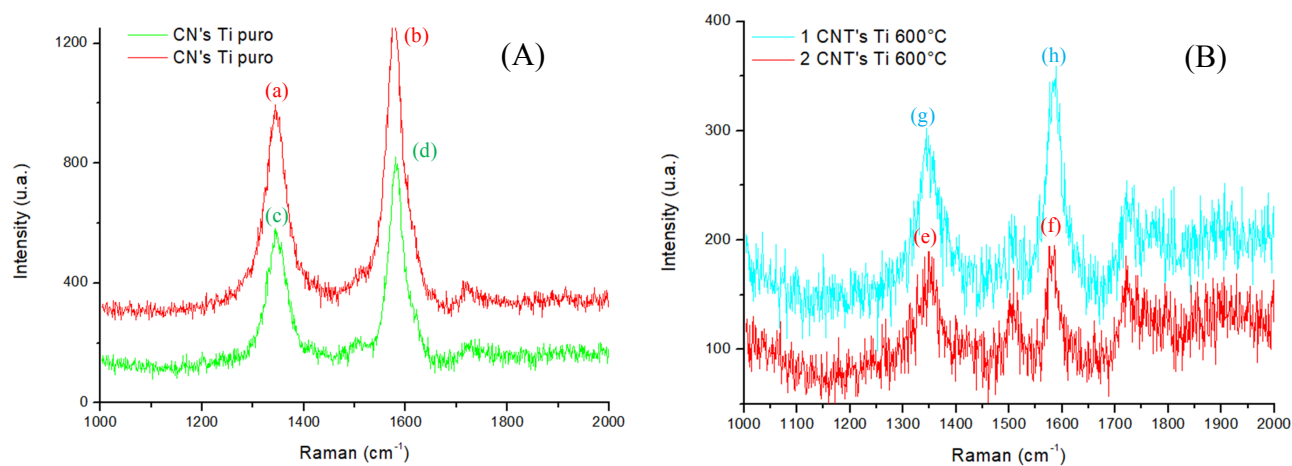


Figure 1. Spectroscopic Raman (a) Titanium de high purity (b) Titanium a 600°C.

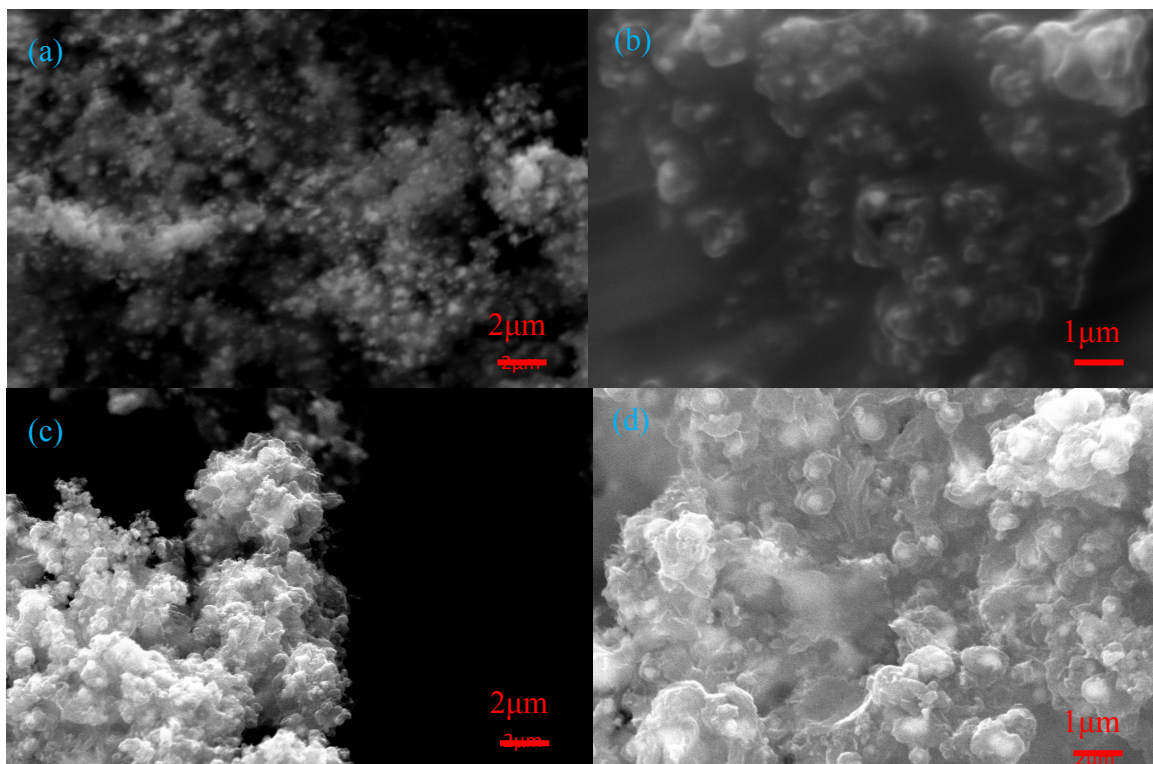


Figure 2. Micrographs (a) magnification at 5kX (b) Magnification at 10kX of Ti at 600°C, (c) magnification at 5kX (d) Magnification at 10kX of Ti high purity.