

## STUDIES OF THE DEPENDENCE OF THE SWNTs LENGTH WITH THE GROWTH TEMPERATURE BY CVD

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The goal of this work is to establish Chemical Vapour Deposition (CVD) conditions that affect the growth of SWNTs with the aim to generate as long as possible SWNTs to be useful for electronics, mechanical, and thermal transport applications.<sup>1,2</sup>

Casting solution of  $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  concentration on a native silicon surface, produce an homogeneous distribution of particles of *ca.* 2 nm height. Adsorption of more concentrated  $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  solutions give rise to inhomogeneous (height ranging from 5-20 nm) and less effective surfaces for the growth of SWNTs.

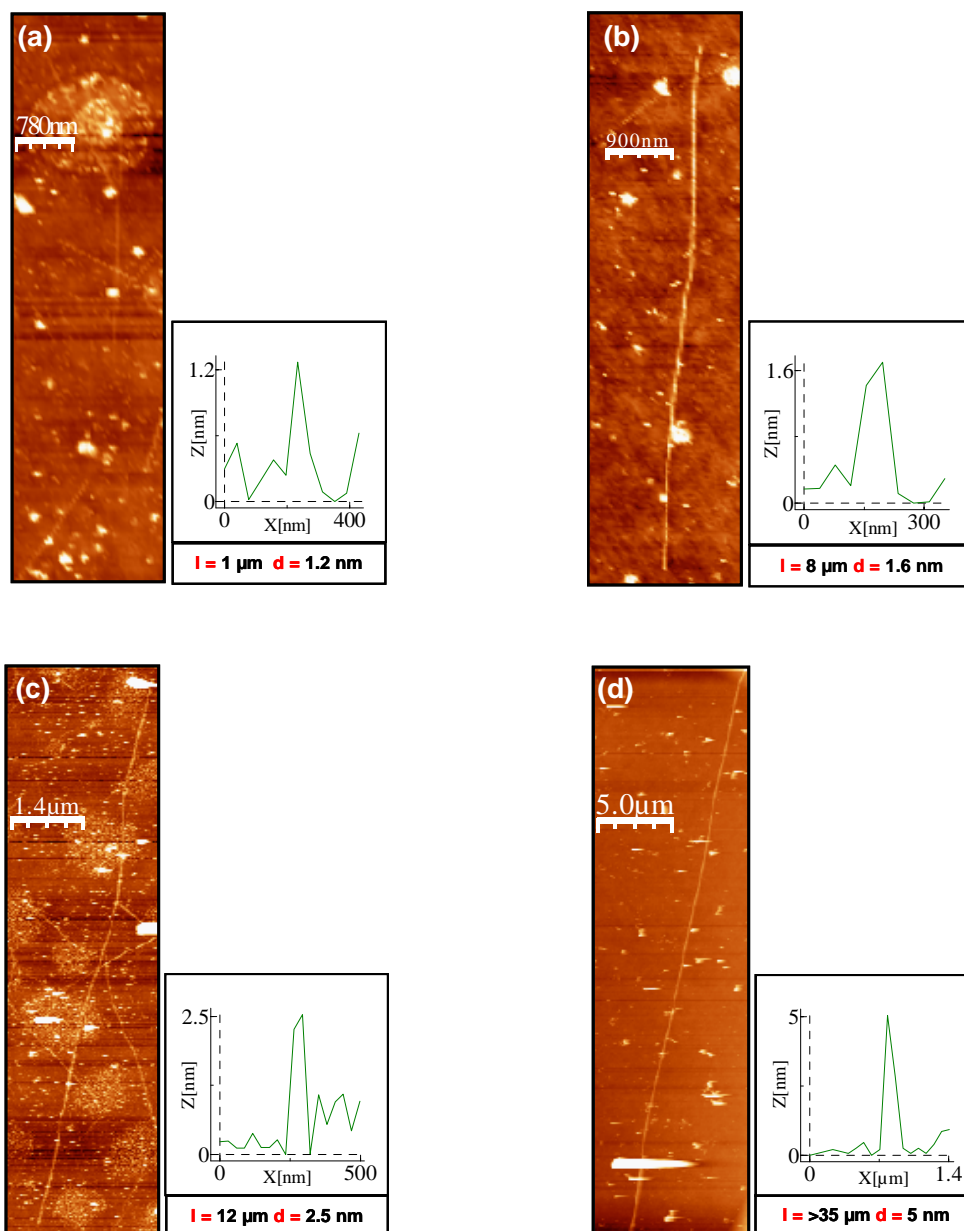
An interesting effect in the length and diameter of the SWNT has been observed in the CVD-growths.

Thus varying the CVD temperature from 800 to 950 °C, the lengths of the SWNTs increase from  $2.6 \pm 0.55 \mu\text{m}$  to more than  $30 \mu\text{m}$  (Figure 1). This effect, is reported herein for the first time, however similar observations have been done in MWNTs (with average diameters from 30 nm to 130 nm).<sup>3</sup> A feasible explanation to this phenomenon could be that the increase of growth rate with the temperature is due to the enhanced diffusion and reaction rates.

On the other hand, the diameters of the SWNT synthesized by CVD varying from  $2.63 \pm 0.55 \mu\text{m}$  (800 °C) to  $>30 \mu\text{m}$  (950 °C) (Figure 1). The migration rate of Fe particles on silicon surface increases with the temperature to facilitate iron aggregation and, therefore, inducing an increase on the SWNTs diameters.

Therefore, this work demonstrates that the temperature is an essential factor allowing the control on the length and diameter of the SWNT growth by CVD.

## Figures:



**Figure 1** AFM topography images of SWNT growth by CVD on silicon substrates: (a) SWNTs growth at 800 °C, length  $2.63 \pm 0.55 \mu\text{m}$  and diameter  $1.7 \pm 0.6 \text{ nm}$ ; (b) SWNTs growth at 850 °C mean length  $8.03 \pm 1.73 \mu\text{m}$  and diameter  $1.7 \pm 0.7 \text{ nm}$ ; (c) SWNTs growth at 900 °C length  $10.87 \pm 1.17 \mu\text{m}$  and diameter  $2.1 \pm 0.9 \text{ nm}$ ; and (d) CNTs growth at 950 °C length  $> 30 \mu\text{m}$  and diameter  $10 \text{ nm}$ .

## References:

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