

Growth of nanotubes inside eDIPS carbon nanotubes

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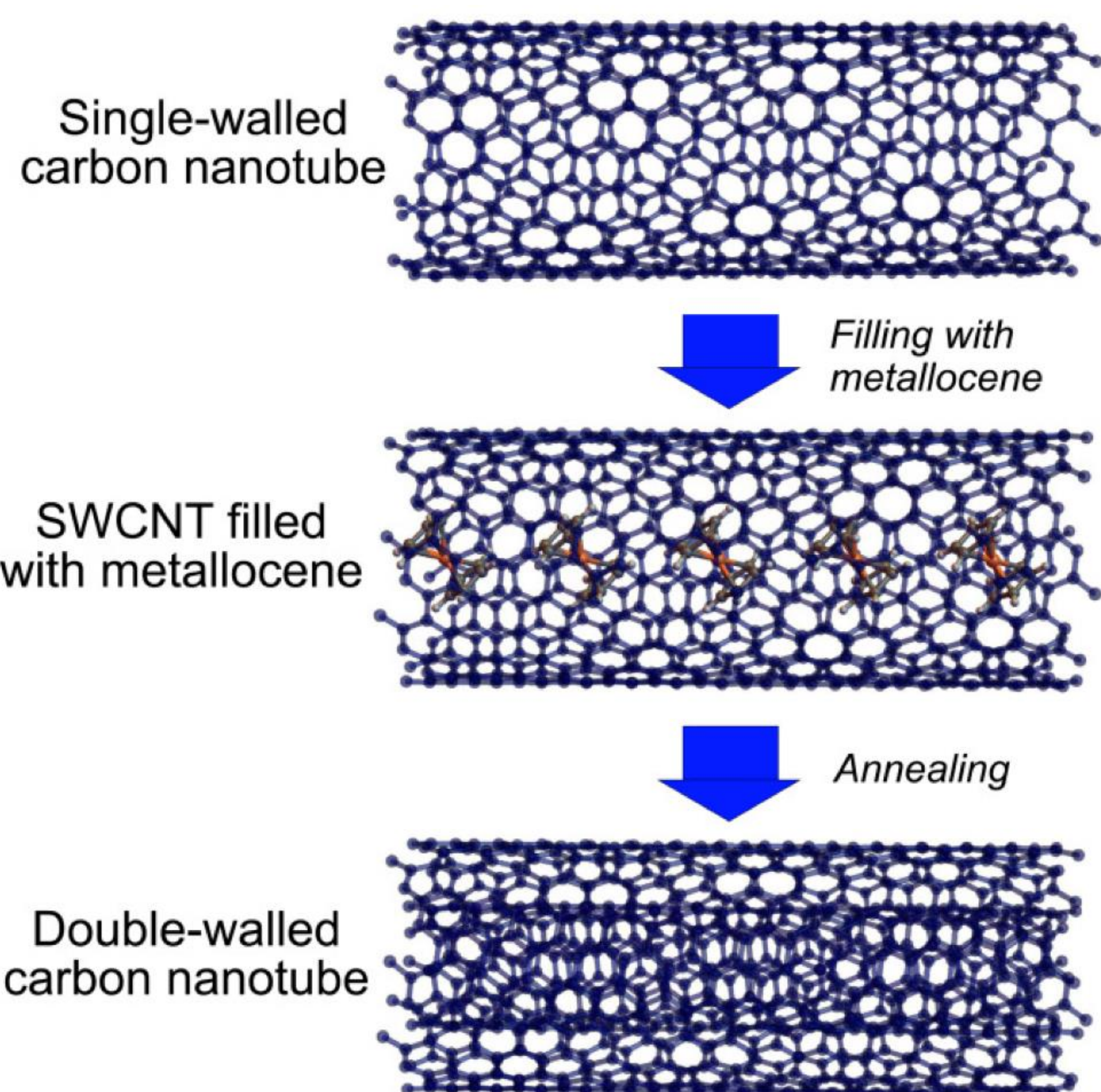
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INTRODUCTION & AIM

The growth of carbon nanotubes is a very important process. It is controlled by the synthesis parameters, such as the catalysts, the catalyst support, the carbon source, temperature, and pressure. There are the different experimental setups for this method. In this work, pristine outer single-walled carbon nanotubes (SWCNTs) are obtained by means of enhanced direct injection pyrolytic synthesis (eDIPS), and they have a diameter of 1.7 nm [1]. They are filled with ferrocene.

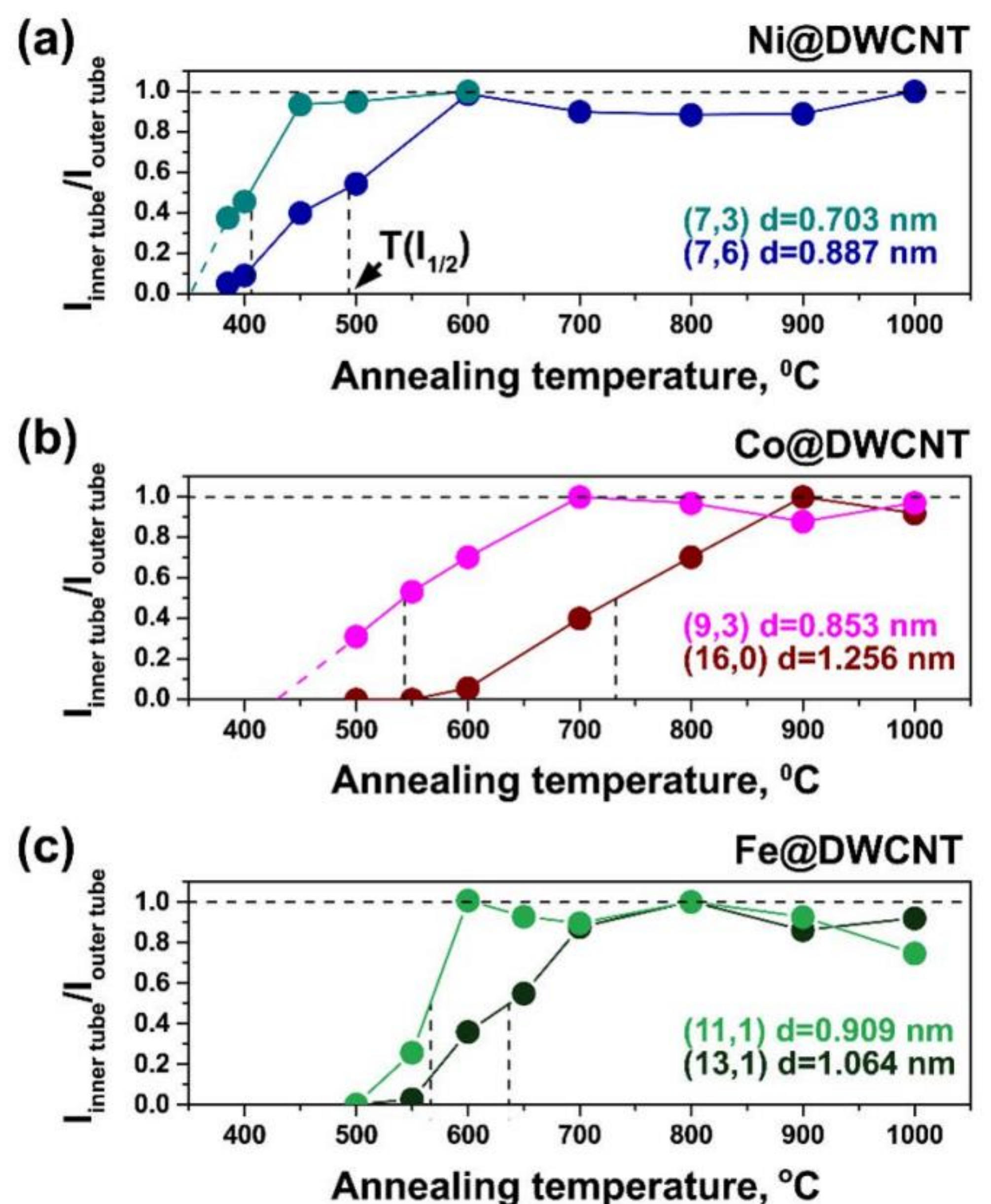
METHOD

The filling of the SWCNTs with ferrocene is performed using the gas phase method at 350°C in a quartz ampoule sealed under an ultrahigh vacuum. The annealing of the ferrocene-filled SWCNTs leads to the growth of the inner SWCNTs with different diameters. Therefore, double-walled carbon nanotubes (DWCNTs) are formed. I analyze all DWCNTs using the Raman spectroscopy method with different laser wavelengths between 458 and 647 nm.



The schematics of filling process of SWCNTs with nickelocene [2]. Copyright 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

RESULTS & DISCUSSION



The growth data of different inner carbon nanotubes inside filled SWCNTs [2]. Copyright 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

CONCLUSION

Thus, in this work, the growth process inside metallocene-filled SWCNTs is traced at different annealing temperatures between 500 and 1000°C. For ferrocene, the growth temperature difference of about 70°C is found for the diameter difference of about 0.16 nm.

FUTURE WORK / REFERENCES

- [1] Saito T., Ohshima S., Okazaki T., Ohmori S., Yumura M., Iijima S. Selective Diameter Control of Single-Walled Carbon Nanotubes in the Gas-Phase Synthesis. *J. Nanosci. Nanotech.* 2008, 8(11), 6153 – 6157.
- [2] Kharlamova M.V. et al. Temperature-Dependent Growth of 36 Inner Nanotubes inside Nickelocene, Cobaltocene and Ferrocene-Filled Single-Walled Carbon Nanotubes. *Nanomaterials* 2021, 11, 2984.