

Growth kinetics of individual carbon nanotubes

Vladimir Pimonov¹, Huy-Nam Tran¹, Thierry Michel¹, Saïd Tahir¹, Léonard Monniello¹, Vincent Jourdain¹

¹ Université de Montpellier, Laboratoire Charles Coulomb (UMR CNRS 5221) & Polytech Montpellier, Montpellier, France
{vincent.jourdain@umontpellier.fr}

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Abstract :

Carbon Nanotubes (CNTs) are one dimensional crystals made of sp² carbon atoms. Their structure could be illustrated by rolling up of graphene layer into a seamless hollow cylinder. In addition to its outstanding mechanical strengths, CNTs have number of optical and electrical properties that makes them applicable in electronic devices. Bottleneck on this way is current impossibility to grow CNTs with desirable structure and density.

Among the numerous methods of nanotubes synthesis, the most frequently used is catalytic chemical vapor deposition (CCVD). This method has a lot of controllable parameters such as temperature, gas pressure, composition of reagents, catalyst type that influence on resulting tubes. On the one hand such variability is a huge advantage that allow to synthesize materials with demanded properties. On another hand, finding of combination of growth parameters that will lead to growth of CNTs with demanded properties is a complex problem which solution is at the core of work of my team.

To achieve this goal, we use unique combination of methods. Our CCVD setup equipped with polarized microscope that allow to observe CNTs during their growth and obtain data about tubes growth rate, incubation and lifetime [1]. Comparison with growth parameters allowed us to find slight trends between nanotubes lifetime and amount of oxygen and water during the synthesis. However, this results are preliminary and statistics still supplemented.

Another point of our project is characterization of grown CNTs with Raman spectroscopy. This method allows to obtain data about vibrational properties of nanotubes which in its turn could be corresponded to CNT's diameter. Using special transition energy tables or as called Kataura Plot it is possible to correlate data about CNT's diameter and chirality [2]. To make such determination more precise we collected broad statistic of CNTs and redefine equation that describe correlation between tubes diameter and vibrational mode.

Further we are going to check if there are correlations between growth parameters, CNT's growth kinetics and its characteristics.

References

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