2016 PKU-UTokyo Nano-Carbon Summer Camp

July 23-28 ,2016
Peking University

北京大學
PEKING UNIVERSITY

東京大学
THE UNIVERSITY OF TOKYO

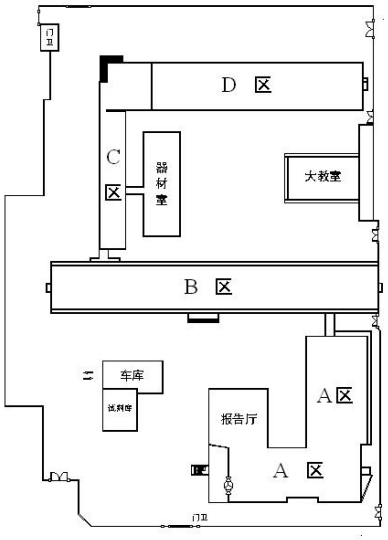
Program for 2016 PKU-UTokyo Nano-Carbon Summer Camp

<table>
<tr><th></th><th>July 23
Saturday</th><th>July 24
Sunday</th><th>July 25
Monday</th><th>July 26
Tuesday</th><th>July 27
Wednesday</th><th>July 28
Tuesday</th></tr>
<tr><td>8:30</td><td></td><td rowspan="4">Openning ceremony
&
Tutorial lectures on nanocarbons
(A717)</td><td rowspan="4">Lab tour</td><td rowspan="4">Team work
(A713 &A813)</td><td rowspan="4">Team work
(A713 &A813)</td><td rowspan="4">Campus tour</td></tr>
<tr><td>9:00</td><td></td></tr>
<tr><td>10:00</td><td></td></tr>
<tr><td>11:00</td><td></td></tr>
<tr><td>12:00</td><td></td><td colspan="4" rowspan="2">Lunch and disscussion</td><td rowspan="12">Utokyo delegate departure</td></tr>
<tr><td>13:00</td><td rowspan="6">Utokyo delegate arrival</td></tr>
<tr><td>14:00</td><td rowspan="5">Self-introduction
&
Forming groups
(A813)</td><td rowspan="5">Team work
(A713 &A813)</td><td>Team work
(A713 &A813)</td><td rowspan="2">Project competition
(A717)</td></tr>
<tr><td>15:00</td><td rowspan="6">City tour</td></tr>
<tr><td>16:00</td><td rowspan="2">Project review
&
Awards
(A717)</td></tr>
<tr><td>17:00</td><td rowspan="2">Reception
(Heyuan)</td></tr>
<tr><td>18:00</td><td></td><td rowspan="4">Banquet</td></tr>
<tr><td>19:00</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>20:00</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>21:00</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Access to PKU, CCME building block A.

Students are recommended to walk ~10 min from hotel to CCME.

Block A



北京大学化学楼分区图

Yan Li-Lab (NMNS Group), in block A, office room number A915

Lab tour

We will visit:
Yan Li-Lab
http://www.chem.pku.edu.cn/page/liy/labhomepage/index.html
Zhongfan Liu-Lab
Jin Zhang-Lab
http://www.chem.pku.edu.cn/cnc/cn/
Anyuan Cao-Lab
http://www2.coe.pku.edu.cn/subpaget.asp?id=333
Lianmao Peng-Lab
http://nano.pku.edu.cn/StaffHome.aspx?person=1

Members

PKU

Huaying Ren *Meng Wang* *Li Ding* *Qiuchen Zhao* *Zhaolong Chen*

Ning Lou *Shi-ting Wu* *Xu Liu(Jon)* *Mengmeng Xiao* *Yang Liu*

UTokyo

Akira KIKUCHI *Ryo Yoshikawa* *Ya FENG* *Shinnosuke Ohyama* *Hua An*

Clement Delacou *Ming Liu* *Takumi Ishikawa* *Takashi Matsumae* *Cheng Wu*

Abstracts

Synthesis of Single-walled Carbon Nanotubes by Using Sputtered Bimetallic catalyst

Hua An[1], Rong Xiang[1], Taiki Inoue[1], Shohei Chiashi[1], Shigeo Maruyama[1,2]

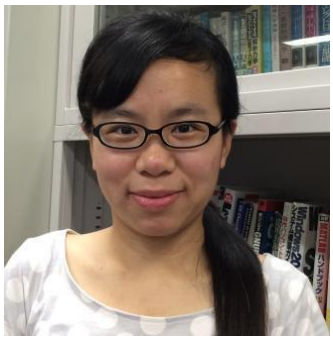
1. Department of Mechanical Engineering, the University of Tokyo, 7-3-1 Hongo, Bunkyo, Tokyo, 113-8656, Japan

2. Energy NanoEngineering Laboratory, National Institute of Advanced Industrial Science and Technology (AIST), 1-2-1 Namiki, Tsukuba, 305-8564, Japan

anhua@photon.t.u-tokyo.ac.jp

Ever since their discovery, single-walled carbon nanotubes (SWNTs) have attracted intensive attention because of their special electronic properties and potential applications. Unfortunately, the as-grown SWNTs are always a mixture of various chiralities, which limits their application in nanoelectronics. Since the chirality determines the structure of SWNTs, diameter control and chirality control are the prerequisite to obtain SWNTs with homogeneous properties. Extensive researches have focused on the diameter-control and chirality-control growth of SWNTs. However, it is a critical challenge to grow single-chirality SWNTs. On the other hand, bimetallic catalysts usually possess different catalytic properties than either of their parent metals and thus they have been widely explored in catalytic reactions for SWNTs growth. Recently, we have tried bimetallic catalysts to grow SWNTs by alcohol catalytic chemical vapor deposition (ACCVD). The catalysts were prepared on silicon substrates by a simple magnetron sputtering method. The SWNTs were characterized by scanning electron microscopy (SEM), Raman spectroscopy, optical absorption spectroscopy and transmission electron microscopy (TEM). We have successfully grown SWNTs with small diameter and narrow chirality distribution by detailed parametric study, which paves a possible way to large-scale industrial applications in nanodevices.

Self-introduction



I am AN Hua, from China. And currently, I am a third-year PhD candidate in the University of Tokyo. My research topic is about the synthesis of single-walled carbon nanotubes. I like all kinds of delicious foods. Hope to make more friends and have fun in Beijing.

Carbon Nanotube and Graphene Applications in Solar Cells

Clement Delacou, Il Jeon, Mohamed Atwa, Masaki Sota, Yutaka Matsuo, Shigeo Maruyama
Maruyama-Chiashi Laboratory, Department of Mechanical Engineering, The University of Tokyo
delacou@photon.t.u-tokyo.ac.jp

Single-Walled Carbon Nanotubes (SWNTs) and graphene have the superiorities in terms of high electrical conductivity at high transparency, combined with earth abundance and chemical stability, they are supposed to be a very promising candidate for next-generation solar cell applications. In Maruyama-Chiashi laboratory, we use ACCVD (Alcohol Chemical Vapor Deposition) for using Ethanol as carbon source initially to grow SWNTs[1] (Fig.1) and then also for growing graphene[2] (Fig.2). Numerous studies on these parameters in our laboratory have enabled to understand better how those factors affects growth in term of size, amount, morphology and quality of these nanocarbon materials.

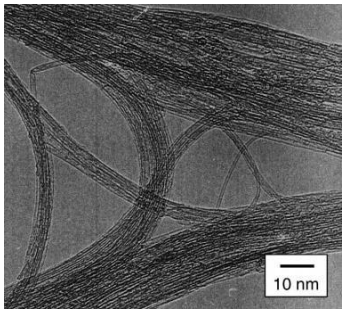


Fig.1 TEM of SWNTs

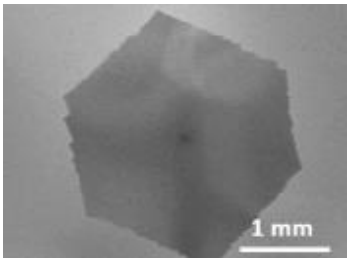


Fig.2 SEM of large size monocrystalline graphene

One application of these nanocarbon materials in solar cell is to replace ITO (Indium Tin Oxide) as transparent electrode in solar cells, because Indium is rare, expensive, fragile and not flexible. But the current challenge here is to create a dense film with both high transparency and high conductivity.

References:

[1] S. Maruyama, R. Kojima, Y. Miyauchi, S. Chiashi, and M. Kohno, Chem. Phy. Lett., 2002
[2] X. Chen, P. Zhao, R. Xiang, S. Kim, J. Cha, S. Chiashi, S. Maruyama, Carbon, 2015

Self-introduction

Birthday: 1990/1/28 (26)
Hometown: Saint Plantaire (village in middle-West of France)
Education: Technical Textile Engineering Master Degree in ENSAIT (in Roubaix, North of France)
Skills: SWNTs and graphene growth, organic solar cell device
Type: Kind, emotional, helpful, creative, social, slow
Hobbies: Guitar, song writing, anime, work out, tennis, running

Experimental investigation of thermal conductivity of single walled carbon nanotube thin film with infrared thermal imager

Ya FENG[1], Taiki INOUE[1], Rong XIANG[1], Shohei CHIASHI[1], Shigeo MARUYAMA[1,2]

[1.]Department of Mechanical Engineering, The University of Tokyo, Tokyo 113-8656, Japan

[2.]Energy NanoEngineering Lab., National Institute of Advanced Industrial Science and Technology, Tsukuba 305-8564, Japan

Fengya@photon.t.u-tokyo.ac.jp

In theory, single walled carbon nanotubes (SWNT) have been proven to be with extraordinarily high axial thermal conductivity owing to its unique quasi-one-dimensional structure[1], thus having been expected to mitigate the severe heat dissipation problem in the continuously shrinking electronic devices. In its bulk counterpart form, the ballistic phonon transfer is seriously impeded by the tube-tube interface scattering, but the remarkable thermal conductivity of single SWNT still boost the application of SWNT thin film as a thermal interface material[2]. Therefore, researches are extensively conducted, trying to precisely measure the thermal conductivity of carbon nanotube films grown in laboratory, which still remains quite a difficulty. Therefore, in this work, we proposed a new method to directly measure the thermal conductivity of SWNT thin film. Two cantilevered silicon thin plates (thickness of 100μm) were joined with the SWNT thin film suspended in between, while the fixed ends were respectively bathed in different temperatures to form a steady state heat flow across. With the infrared thermal imager recording the temperature distribution along the targeted structure, the silicon plates with known thermal conductivity can work as a reference to calculate the heat flux transporting through the SWNT thin film. Repeating the experiment without the SWNT thin film, the effect of thermal radiation can be neatly deducted.

[1] MS Dresselhaus et al. Adv. Phys. 49 (6), 705-814 (2000).

[2] Tong Tao et al. IEEE T Compon. Pack. T 30 (1), 92-100 (2007).

Self-introduction

My name is Feng Ya, sophomore of doctor course in Mechanical Engineering, the University of Tokyo. I am Chinese, from Hunan Province, once lived in Beijing for three years during my master course at Chinese Academy of Sciences. I am not a sociable person, so I prefer to be left alone and read a book.

Study on the friction properties of a-C:H films in a microstructural point of view

Takumi Ishikawa, Junho Choi
Department of Mechanical engineering
ishikawa@sstl.info

Hydrogenated amorphous carbon (a-C:H) films have been gathering attention recently for their high hardness, chemical inertness, low friction coefficient and high wear resistance, which enable a-C:H films to be a good coating materials in tribology fields. On the other hand, these properties are greatly influenced by microstructure of a-C:H films, and the microstructure is changed according to coating methods and parameters. In our previous study, Raman spectroscopy was used to clarify the microstructure of a-C:H films, and the microstructure of a-C:H films evaluated by Raman parameters and the mechanical properties of the films were successfully correlated. In this study, The correlation between the microstructure of a-C:H films and their tribological properties was investigated.

From the evaluation of the microstructure of a-C:H films using Raman spectroscopy, it was found that the structure of a-C:H films can be classified into three main categories. i.e., polymer-like carbon (PLC), diamond-like carbon (DLC) and graphite-like carbon (GLC) structures. a-C:H films with DLC structure showed the highest friction coefficient among these three carbon structures. Also, the friction coefficient of DLC structured a-C:H film increases in proportion to their hardness. By investigating the friction surface, we found that chemical species generated during friction may be the main reason which affects the friction coefficient. Higher the friction coefficient is, more oxidation species is generated during friction. It is known that the surrounding environment (water, oxygen, etc.) affect the friction performance of a-C:H films dramatically because they can easily react with the surface chemically.

Self-introduction

I'm 24 years old. My hometown is Aichi prefecture (near Nagoya), but I live in Tokyo now since my university is there. I have lived in Los Angeles when I was a child for four years. Now, I belong to the tribology laboratory, and I'm majoring in friction. I like to play sports, especially, soft tennis and basketball. Also, I like to read books and watch movies. I want to know more about nano carbon material, and its properties, I'm looking forward to this program.

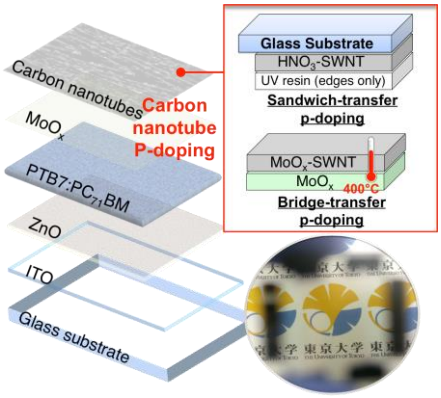
Window-like Organic Solar Cells with p-Doped Carbon Nanotube

Il Jeon[1], Clement Delacou[1], Shigeo Maruyama[1,2], and Yutaka Matsuo[1]

[1] Department of Mechanical Engineering, The University of Tokyo, [2] National Institute of Advanced Industrial Science and Technology (AIST)

il.jeon@photon.t.u-tokyo.ac.jp

Organic solar cells are flexible and inexpensive, and they are expected to have a wide range of applications. In addition, many transparent organic solar cells have been reported and their success hinges on full transparency, high power conversion efficiency, and low-cost fabrication. Recently, carbon nanotubes and graphene, which meet these criteria, have been used in transparent conductive electrodes. However, their use in top electrodes has been limited by mechanical difficulties in fabrication and doping. Here, expensive metal top electrodes were replaced with high-performance, easy-to-transfer, aerosol-synthesized carbon nanotubes to produce transparent organic solar cells. The carbon nanotubes were doped by two methods developed in this work: HNO_3 doping via 'sandwich transfer', and MoO_x thermal doping via 'bridge transfer'. Although both of the doping methods improved the performance of the carbon nanotubes and the photovoltaic performance of devices, sandwich transfer, which gave a 4.1% power conversion efficiency, was slightly more effective than bridge transfer, which produced a power conversion efficiency of 3.4%. Applying a much thinner carbon nanotube film with 90% transparency decreased the efficiency to 3.7%, which was still high. Overall, the transparent solar cells had an efficiency of around 50% that of non-transparent metal-based solar cells (7.8%).



Self-introduction

I was born in Korea, but I grew up in England since I was 13. I read Chemistry for both Bachelors and Masters degrees at the University of Oxford, UK. Upon graduation, I worked as the youngest senior researcher in LG Display, South Korea for 4.5 years with the military service exemption. I did my PhD at the University of Tokyo and finished it with Summa Cum Laude. I am now a JSPS Postdoctoral Fellow under Prof. Shigeo Maruyama working on graphene and carbon nanotube materials, and their photovoltaic applications.

Observation of biased graphene by passive THz microscope with nanoscale resolution

Akira KIKUCHI[1], Kuan-Ting LIN[2], Yusuke KAJIHARA[3]

Department of Precision Engineering

kikuchi9@iis.u-tokyo.ac.jp

We have a new microscopy technique, which probes surface of samples and observes THz wave emitting from it with nanoscale spatial resolution. We have created a passive THz near-field microscope by introducing an ultra-high sensitive THz detector (CSIP) and a scattering–type scanning near-field optical microscope. Fig.1(a) shows mechanism of our device, and Fig.1(b) shows real figure of it. Graphene is a promising material for new technology, and we are interested in its electrical conductivity. We have observed graphene sample which is electrically biased and researched characteristic of it. We show a result of it and propose another experiment using graphene.

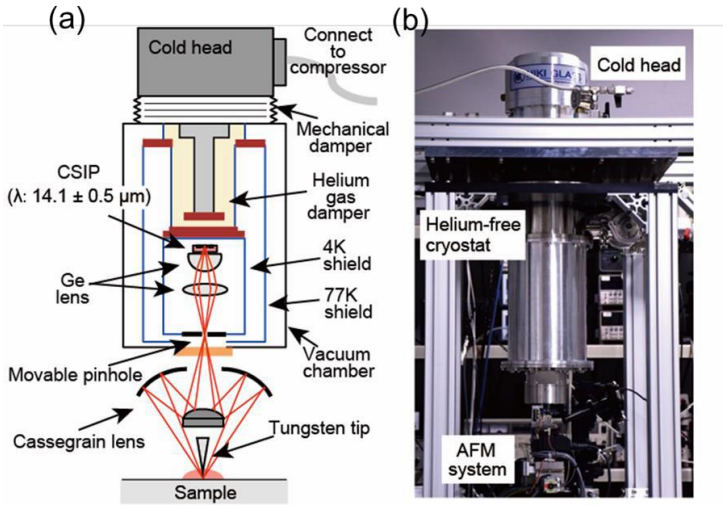


Fig.1 Mechanism of THz microscope

Self-introduction

I am 24-years old, and live in Setagaya-ku, Tokyo. My home town is Yashima, Kagawa prefecture where is famous for Udon which is delicious noodle made from wheat. I have been doing Kendo for 18 years, and I am a good player of it. Kendo is one of the most famous sports in Japan, and it is a martial arts and origin from Samurai who lived long ago in Japan..

Towards High Temperature Surface Enhanced Raman Scattering by Ag/SiO_2 nanocomposites during Growth of Single-walled Carbon Nanotube

Ming Liu[1], Rong Xiang[1], Shigeo Maruyama[1],

[1] Department of Mechanical Engineering, the University of Tokyo, Japan

liuming@photon.t.u-tokyo.ac.jp

The growth process of the single-walled carbon nanotube (SWCNTs) during chemical vapor deposition is monitored by *in-situ* Raman spectroscopy and the possibility of using metal nano-particles to enhance the Raman scattering at high temperatures has been confirmed.[1] Since the morphology of silver is changing when the temperature increases, which would lead to the enhancement decrease at high temperatures, we are devoted to improve the stability of silver particles at high temperatures. $Ag@SiO_2$ core-shell particles could satisfy the requirement of improving the stability of silver particles at high temperatures, because silicon dioxide can be stable under the high temperatures over 1000^oC[2] which is much higher than the growth temperature of SWCNTs. After a systematic optimization of particle size, silicon dioxide thickness, stability of silver particle film, we demonstrate a real time mapping of the growth process using $Ag@SiO_2$ surface enhanced Raman scattering substrate.

References

1.Liu, M.; Xiang, R.; Cao, W.; Zeng, H.; Su, Y.; Gui, X.; Wu, T.; Maruyama, S.; Tang, Z. *Carbon* **2014,** 80, 311-317.

2.Tada, H.; Kumpel, A. E.; Lathrop, R. E.; Slanina, J. B.; Nieva, P.; Zavracky, P.; Miaoulis, I. N.; Wong, P. Y. *Journal of Applied Physics* **2000,** 87, (9), 4189-4193.

Self-introduction

My name is Ming Liu, I am from Dandong, Liaoning Province, China. I got my bachelor degree in Material Physics from Sun Yat-sen University. Now, I am the first-year master student in Department of Mechanical Engineering, the University of Tokyo. I like running and doing sports like table tennis, billiards and tennis.

Synthesis and characterization of SWNTs using W-Co catalyst with low pressure CVD

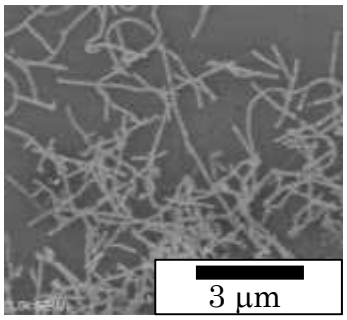
Shinnosuke Ohyama[1], Hiroki Takezaki[1], Feng Yang[2], Daqi Zhang[2], Taiki Inoue[1], Rong Xiang[1], Shohei Chiashi[1], Yan Li[2], Shigeo Maruyama[1,3]

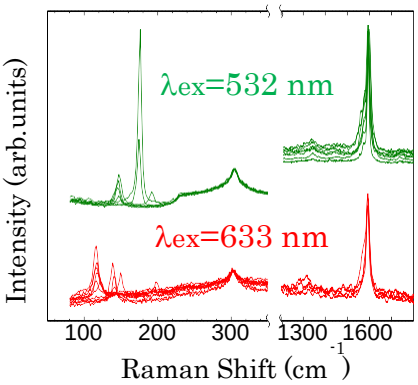
[1] The University of Tokyo, [2] Peking University, [3]AIST

e-mail: ohyama@photon.t.u-tokyo.ac.jp

Chirality controlled growth of SWNTs is highly expected toward the applications of SWNTs. Recently, it was reported that W_6Co_7 alloy catalyst realized the growth of single-chirality SWNTs with purity over 90% through pretreatment and growth at high temperature [1]. In order to investigate the controlled-growth mechanism and to conduct the experiment safely, we grew SWNTs using W-Co catalyst via ethanol CVD under much less hydrogen and lower pressure conditions. Owing to a narrow growth window of SWNTs at high temperature, we varied the growth parameters to search for appropriate conditions. As a result, we succeeded in growing SWNTs at over 1000 ℃ under a condition where partial pressure of ethanol and hydrogen was 100 and 150 Pa, respectively, and total pressure was 5.0 kPa. Raman spectra of the grown SWNTs were measured to examine the chirality distribution.

[1] F. Yang et al., Nature 510, 522 (2014).





Self-introduction

Name: Shinnosuke Ohyama（大山真之介）

Age: 23

Hometown: Tokyo

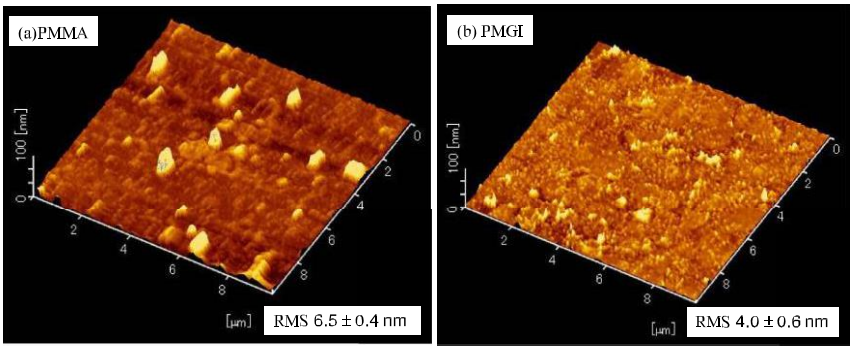
Interests: Baseball, Beer, Horse Racing

A Scalable Clean Graphene Transfer Process Using Polymethylglutarimide as a Support Scaffold

Takashi Matsumae, and Tadatomo Suga

The University of Tokyo

Extrinsic scattering related to polymer residue limits the performance of chemical vapor deposited graphene films when transferred to insulating substrates. A clean graphene transfer process has been achieved by employing a support scaffold composed of a polymethylglutarimide (PMGI)-based resist. Scanning electron microscopy (SEM) and atomic force microscopy (AFM) observations confirmed that the amount of residue on large-area transferred graphene was sufficiently reduced by using PMGI scaffolds in comparison to the traditional technique that uses polymethyl methacrylate (PMMA) scaffolds. The root mean square (RMS) roughness values of graphene surfaces using PMMA and PMGI scaffolds were 6.5 nm and 4.0 nm, respectively. This comparison confirms that a cleaner graphene surface was achieved by using PMGI as a support scaffold. Furthermore, Raman spectroscopy suggests that the quality of the transferred graphene was equivalent to that obtained by the traditional method.



Changes in graphene surface morphology caused by residues from (a) PMMA and (b) PMGI scaffolds.

Self-introduction

Takashi Matsumae

Affiliation:

The University of Tokyo, Ph. D candidate

Research Interest:

Semiconductor manufacturing process.

Personal Interest:

I have never eaten 北京烤鸭 before until now.

Research Abstract

Synthesis of Small Diameter Single-Walled Carbon Nanotubes Using Zeolite-Supported Catalytic CVD

Cheng Wu[1], Bo Hou[2], Rong Xiang[1], Taiki Inoue[1], Shohei Chiashi[1] and Shigeo Maruyama[1,2]

[1] Department of Mechanical Engineering, the University of Tokyo, Tokyo 113-8656, Japan

[2] Energy NanoEngineering Lab., Department of Energy and Environment, AIST, Tsukuba 305-8564, Japan

wu@photon.t.u-tokyo.ac.jp

Growth of small diameter SWNTs has been rarely covered in previous work and its yield is usually quite limited. However, we found abundant existence of super small SWNTs, such as (6, 4), (5, 4), etc… which are smaller in diameter than (6, 5) (~0.8nm), when we extend CVD conditions (350 ^{o}C ~ 950 ^{o}C, 10^{-2}Pa ~ 10^{4}Pa) using zeolite-supported alcohol catalytic CVD, compared to conventional ones. Here we used resonant Raman spectroscopy, absorption and photoluminescence mapping to assign the chirality and abundance. Besides, to further understand the growth mechanism of small diameter SWNTs, the extended CVD has been intensively investigated. We found a proportional relation of pressure and temperature for growth of unity quality of SWNTs and near defect-free SWNTs can be obtained at high temperature and moderate pressure region.

Self-introduction

My name is Cheng WU. I am from Hunan, China and I am 23. I got my bachelor degree of engineering from Dalian University of Technology. I am now in my first year of master course in the University of Tokyo and my research topic is on synthesis of carbon nanotubes.

I like reading and music. Besides, playing online games is also a good way for me to kill time and relax. And I've also started to work out in the gym recently.

Chirality Determination of Single-Walled Carbon Nanotubes in Molecular Dynamics Simulation

Ryo Yoshikawa[1, 2], Yukai Takagi[1], Hiroyuki Ukai[1], Shohei Chiashi[1], Shigeo Maruyama[1, 2]
[1]The University of Tokyo, [2] National Institute of Advanced Industrial Science and Technology (AIST)
yoshikawa@photon.t.u-tokyo.ac.jp

Molecular dynamics (MD) simulations are powerful tools to analyze the growth mechanism of single-walled carbon nanotubes (SWCNT) on atomic scale[1], which is difficult to observe experimentally. However, it was difficult to determine the chirality of SWCNTs in MD simulations because of their structural defects, despite some report of chirality selective growth in experiment[2]. In this study, we put a catalytic metal nanoparticle at the center of a 10-nm cubic cell, and provided gas-phase carbon atoms one by one to keep the free carbon density. We used Tersoff-type potential function which we originally made for interaction between carbon atoms and metal atoms, and between metal atoms, Brenner-Tersoff potential for that between bonded carbon atoms, and Lennerd-Jones potential for that between unbonded carbon atoms. We imposed periodic boundary conditions along three axes, and controlled the temperature of the metal particle by Nosé-Hoover thermostat. As a result, we successfully reproduced the growth of defect-free SWCNTs in MD simulations by tuning the growth conditions, and determined the chirality of them. We made development view of these SWCNTs and succeeded in observing the growth mechanism of zigzag and near-zigzag SWCNTs.

In addition, we observed several types of alloyed catalyst including Fe-Co, Cu-Co and W-Co in our simulations, using new Tersoff-type potential. SWCNT growth from these catalysts will also be discussed.

[1] Y. Shibuta and S. Maruyama, *Chem. Phys. Lett.*, **382** (2003) 381.
[2] F. Yang, et al, *Nature*, **510** (2014) 522.

Ryo Yoshikawa

Birthplace: Mito, Ibaraki (Japan) *Birthday*: September 18, 1992
Education: Mito First High School – Natural Science 1, College of Arts and Sciences, UTokyo – Department of Mechanical Engineering, School of Engineering, UTokyo
Interested in: Bicycle, guitar, violin, piano, baseball, cooking…
Like: Birds, small animals, season events…

Fast and Uniform Growth of Graphene Glass using Confined-Flow CVD and Its Applications

Zhaolong Chen[1], Xudong Chen[1], Zhongfan Liu[1,*]

1Center for Nanochemistry (CNC), College of Chemistry and Molecular Engineering, Beijing, 100871

Chenzl-cnc@pku.edu.cn

Graphene glass integrates the fascinating properties of pristine graphene and widely-used glasses, offering great potentials for practical applications of graphene in our daily life[1,2]. One of the technical hurdles toward the wide applications of graphene glass is the slow growth kinetics of graphene on glasses in the CVD process[1]. We report herein a confined-flow CVD approach by creating a 2-4 μm wide gap above the glass substrate with plenty of stumbling blocks for the high-efficiency fabrication of graphene glass. As a result, the growth rate of graphene glass was remarkably increased together with an improvement of growth quality and uniformity as compared to the conventional gas flow CVD technique. Thus-obtained high quality graphene glasses exhibited an excellent defogging performance and the graphene sapphire glass was found to be an ideal substrate for growing uniform and ultra-smooth aluminum nitride (AlN) thin films without the tedious pre-deposition process of a buffer layer.

Reference:

[1] Sun, J.; Chen, Y.; Priydarshi, M. K.; Liu, Z. *Nano Lett.* **2015, 15,** 5846-5854.

[2] Chen, Y.; Sun, J.; Gao, J.; Liu Z. *Adv. Mater.* **2015, 27,** 7839-7846.

Self-introduction

My name is Zhaolong Chen. I come from Weifang, Shandong province and my major is direct growth of graphene on glass Badminton, swordsman books, and climbing mountains are my favorites. What's more, I am good at cooking, and l love delicious food.

Solvothermal preparation of uranium oxide supported on reduced graphene oxide

Li Ding, Yan Li

Key Laboratory for the Physics and Chemistry of Nanodevices, Beijing National Laboratory for Molecular Science, College of Chemistry and Molecular Engineering, State Key Laboratory of Rare Earth Materials Chemistry and Applications, Peking University, Beijing 100871, China

lidingxmu@gmail.com

Uranium oxides have been used as good catalysts for different kinds of reactions owning to their special structural features and chemical properties [1]. The oxidation state of uranium is a crucial factor influencing its catalytic performance. Thus, the synthesis of pure phase uranium oxides with different oxidation states is very important for studying their catalytic properties [2]. Previously, uranium oxide at the nano size were synthesized in a mixture of oleic acid (OA) and, oleylamine (OAm) which surrounded the surface of particle and further hindered the application in catalysis [3][4]. In the present work, the uranium oxides loaded on the reduced graphene oxide (rGO) sheets were synthesized by solvothermal route as shown in Scheme 1. We found that the composition of the solvent is a key issue for controlling the phase of the products.The water present in the solvent was benefical for the formation of U_3O_8.And UO_2 was obtained favorablely in the solvent with ethylene glycol.

[1] Taylor, S. H. *et al.*, Nature **1996,** *384*(6607), 341-343.

[2] Idriss, H. *et al.*, Journal of Catalysis **2004,** *224*(2), 358-369.

[3] Meyer, D. *et al.*, Nano Research **2013,** *7*(1), 119-131

[4] Cao, Y. C. *et al.*, Journal of the American Chemical Society **2006,** *128*(51), 16522-16523

Corresponding Author: Yan Li

Tel: +86-10-62756773, Fax: +86-10-62751708;

E-mail:yanli@pku.edu.cn;

Self-introduction

Hello, I am Li Ding. I was born in 1990. This is my third year at Peking University. My research focus on the preparation, characterization and application of uranium based materials. I am interested in synthesis of the uranium oxides with differernt size and morphology. Also I pay much attention to make a select for a potential application of these new materials.

Room temperature broadband infrared cascading detector based on carbon nanotube with high responsivity, detectivity and stability

Yang Liu, Lian-Mao Peng

Key Laboratory for the Physics and Chemistry of Nanodevices and Academy for Advanced Interdisciplinary Studies, Peking University, Beijing 100871, China

email：liuyangly@pku.edu.cn

Infrared (IR) detectors are important for a variety of industrial and scientific applications such as IR imaging, biological sensing, day and night surveillance and communication. However, most high-end IR detectors made of conventional semiconductors need to be cooled to achieve high performance, and these materials are usually not stable under strong illumination. Carbon nanotubes (CNTs) are direct-bandgap materials with broad spectral response and large absorption coefficient. Existing CNT based IR detectors, however, either require bias to operate or are based on individual CNTs with limited absorption and thus performance. Here, we show that contacts dominated high performance photodiodes or IR detectors can be constructed based on high-purity solution-processed CNTs via a doping-free technique, which can further be combined with virtual contacts to multiply photovoltage and thus to improve the signal to noise ratio. Using photovoltage as the signal, it is shown that the CNT film based IR detector has a broadband response from 1200 nm to 2100 nm, high room temperature responsivity and detectivity of up to 1.5×10^{8} V/W and 2.91×10^{11} Jones separately, which can be compared with state-of-the-art InGaAs detectors, and extremely good temperature and temporal stability. Large scale fabrication potential is also demonstrated by fabricating a 150×150 photodetector array on a two inch wafer. Electric and optoelectronic tests on randomly selected 72 detectors reveal excellent device performance uniformity with a yield of 100%.

Self-introduction

I'm twenty-five years old, born in Inner Mongolia. Now I am a Ph. D candidate under the supervision of Prof. Lian-Mao Peng in the Academy for Advanced Interdisciplinary Studies, Peking University. I obtained BE on Semiconductor Physics and Device from Jilin University in 2013. Currently my research interests are on nanoscale photodetector and monolithic optoelectronic integration in the Key Laboratory for the Physics and Chemistry of Nanodevices, Peking University. I am also interested in Chinese Calligraphy and painting.

Synthesis tungsten-based solid alloy catalysts to grow chirality-specific SWNTs

Xu Liu

Jonliuseason@pku.edu.cn

In 2014, we have reported the W-Co intermetallic compound as the catalyst to achieve a (12,6) selectivity of more than 92%. The in situ TEM measurements reveal that the catalysts particles remain solid crystalline structure even when heated up to 1100 degree centigrade. The high resolution TEM shows the (12, 6) tube grows on the (0 0 12) plane of the catalyst, which implies the vapor-solid-solid (VSS) epitaxial growth mechanism. When we change the growth condition, we also get a (16,0) selectivity of more than 80%.

In the experiment, it takes a long time for precursor solution evaporation. Such a long time gives the opportunity for solute aggregation. In order to reduce aggregation, we would like to choose the volatile solvent, to dip precursor solution to the chip. Because of the negative charge of the cluster, a kind of quaternary ammonium salt with positive charge, was used to promote the solubility by interfacial adsorption.

Reference:

F. Yang, X. Wang, D.Q. Zhang, J. Yang, D. Luo, Z.W. Xu, J.K. Wei, J.-Q. Wang, Z. Xu, F.Peng, X.M. Li, R.M. Li, Y.L. Li, M.H. Li, X.D. Bai, F. Ding, Y. Li*. Chirality-specific growth of single-walled carbon nanotubes on solid alloy catalysts. Nature, 510, 522-524 (2014).

F. Yang, X. Wang, D.Q. Zhang, K. Qi, J. Yang, Z. Xu, M.H. Li, X.L. Zhao, X.D. Bai, Y. Li*, Growing Zigzag (16,0) Carbon Nanotubes with Structure-Defined Catalysts. J. Am. Chem. Soc.,137, 8688-8691 (2015).

Self-introduction

I am Jon, a 23 years old student of Yan Li's group, who has just finished my first year as a PhD candidate. I received my B.S. from Taishan college, Shandong University, 2015. I like playing basketball and watching football games..

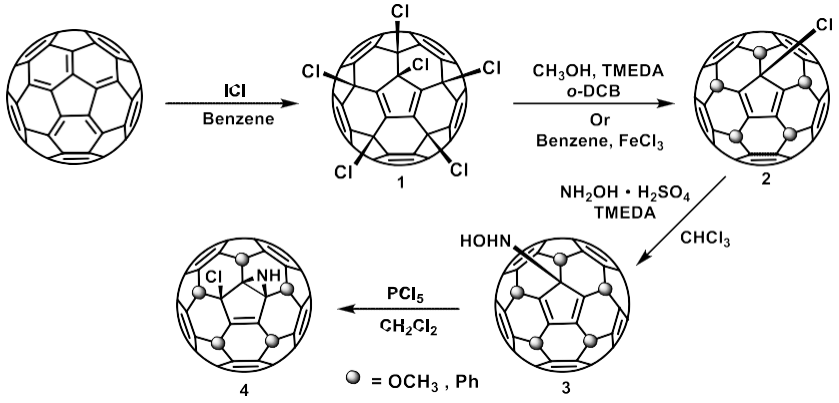
Synthesis of Azafullerene $C_{59}NR_5$ and Azafulleroid $C_{60}NAr_5$

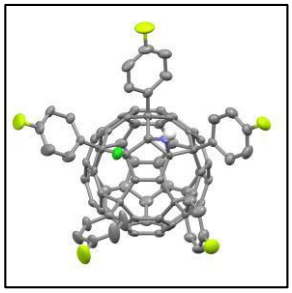
Ning Lou[1], Liangbing Gan[1]

[1]The Key Laboratory of Bioorganic Chemistry and Molecular Engineering of Ministry of Education, College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, China

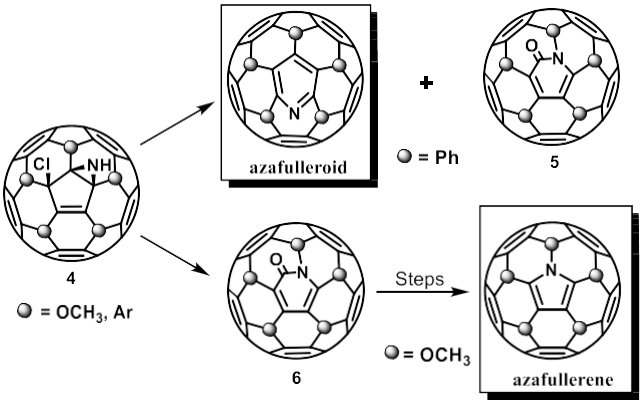
louning@pku.edu.cn

Skeleton modification of C_{60} has resulted in many novel fullerene derivatives. Partial replacement of the carbon atoms on the fullerene cage by one or more heteroatoms can generate numerous heterofullerenes and hydroxylamine has been shown to be an effective reagent for the introduction of nitrogen atom onto the fullerene skeleton. Herein we present a hydroxylamine based method to synthesize both azafullerene and azafulleroid derivatives.





X-ray structure of **4**



Self-introduction

My name is Ning Lou and I am a third-year graduate student of Department of Organic Chemistry. Despite I spend 12 hours each day and 6 days each week in the laboratory doing experiments, nothing significant has been achieved yet. In my spare time after work, if not in sleep, I usually watch movies or go to gym. I am a marvel fun, a food lover and a joke maker. Nice to meet you all.

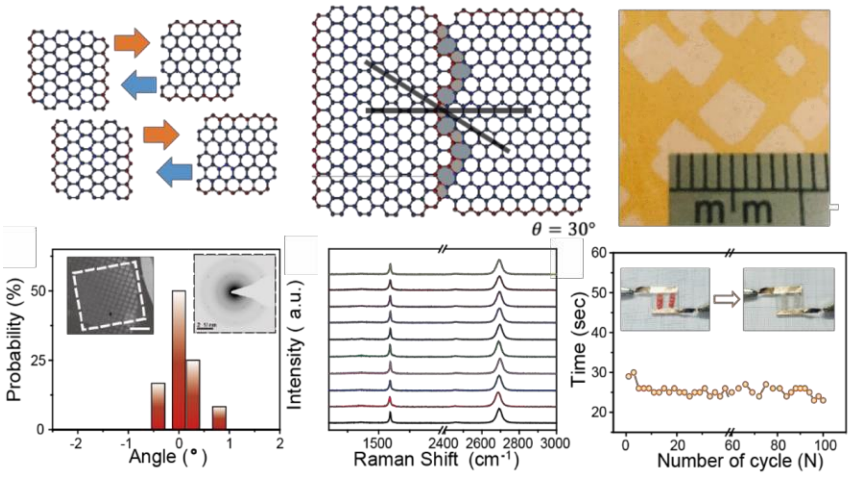
Rapid Growth of Angle Confined Large domain sized Graphene Array by Passivation Method

Huaying Ren[1, 2], Hailin Peng[1,*], Zhongfan Liu[1,*]

[1] College of Chemistry and Molecular Engineering, [2] Academy for Advanced Interdisciplinary Studies, Peking University, Beijing 100871

renhy-cnc@pku.edu.cn

Grain boundaries (GBs) derived from coalescence of graphene domains via chemical vapor deposition degrade its excellent intrinsic nature, which largely impedes the quality of industrial graphene product. To settle this matter, methods involving full control of the number of nucleation centers and the control of the lattice orientation of graphene grains have been established variedly. Here, we present a simple catalytic surface processing method for growing well-aligned large-domain graphene bicrystals with a confined twist angle of 30°. Further nucleation density control was realized by combining with a catalytic surface passivation treatment and a 6 mm sized single-crystalline domain was successfully obtained under a considerable growth speed. A series of characterizations was conducted to demonstrate the high quality of the as-grown graphene. Our work provides an alternative design of process engineering with rapid synthesis of high-quality film with large-domain graphene bicrystals to satisfy a variety of practical applications.



Self-introduction

Ren Huaying(任华英) comes from JINAN the Spring City, Shandong Province, and is a 3rd year graduate student at PKU. I have been in Japan in 1998 and 2015. I found new-age music and OSTs are most enjoyable and my favorite musicians are Yuki Kajiura and Yoko Kanno. I love swimming, jogging and paper model making, reading detective novels.

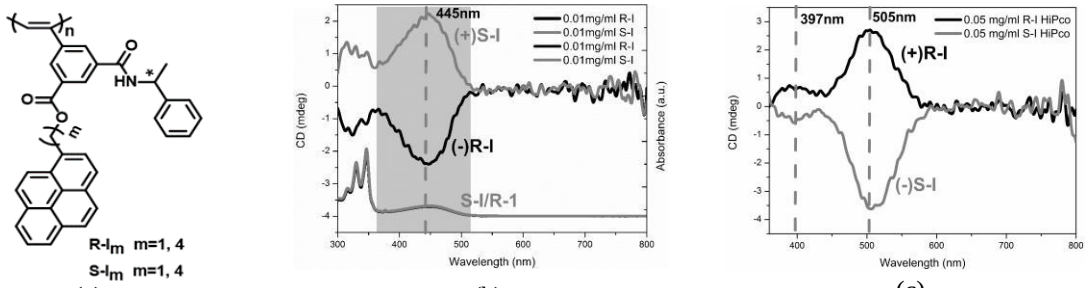
Handedness Enantioselection of Single-Walled Carbon Nanotubes Using Chiral Pyrene- moieties Polyacetylenes Polymers

Meng Wang[1], Sheng Wang[2], Juan Yang[1], Xinhua Wan[2*], Yan Li[1*]

[1] Department of Inorganic Chemistry, College of Chemistry and Molecular Engineering, Peking University; [2] Key Laboratory of Polymer Chemistry and Physics of Ministry of Education, College of Chemistry and Molecular Engineering, Peking University

email_dreamwang@pku.edu.cn

Synthesized single-walled carbon nanotubes (SWCNTs) are mixtures of right- and left-handed helicity and their separation is an essential topic in nanocarbon science. Several methods have been used in the isomer separation of SWCNTs. Here, we designed and synthesized a chiral conjugated polymers composed of polyacetylenes chains with chiral moiety and pyrene-based side chains (denoted **R-I** and **S-I**, respectively) (**Figure a**). Our strategy is using these polymers to achieve handedness enantioselection of raw SWCNTs. The sample solutions were prepared by a simple one-pot sonication and centrifugation, and then confirmed by circular dichroism, UV-Vis IR and photoluminescence spectroscopies. It was found that, the chiral polymer (**R-I** and **S-I**) can promote the dispersion of SWCNTs in NMP solution; the inversion of the spectral signals of the polymer-SWCNTs complex occurs, compared to the original CD signal of the polymer, and ＞60 nm red-shift of peak position was observed (**Figure b and c**).



(a) (b) (c)

Figure: (a) chemical structures of **R-I** and **S-I**; CD spectra of (b) R-I/S-I solutions and (c) **R-I/S-I** SWCNTs dispersion solutions.

Self-introduction

Hello! I'm Meng Wang, a PhD candidate of Chemistry. Graduating from Shandong University in 2014, I became a student of Peking University. Different from my hometown Dezhou (in Shandong Province), Beijing is more diverse and prosperous. But, there is still something to brag about: ***Dezhou braised chicken***, my hometown special product, is as well-known as ***Peking duck***. I like reading and calligraphy. Expect to be friends with you!

Blown Bubble Assembly of Nanomaterials and Graphene-Hybridized Structures for Advanced Electronic Nanodevices

Shi-ting Wu[1], Wenjing Xu[1], Mingchu Zou[1], Liusi Yang[1], Huaisheng Wu[1], Anyuan Cao[1]

[1]Department of Materials Science and Engineering, College of Engineering, Peking University, China

wushiting2012@pku.edu.cn

To fabricate function systems, nanomaterials must be assembled in large scale with controlled orientation and distance. Here we report a polymer-based bubble method to assemble both one- and two-dimensional nanomaterials over large area, and then fabricate graphene-hybridized structures consisting of aligned nanomaterials for advanced electronic nanodevices.

We select polymethylmethacrylate (PMMA), a conventional polymer used as photoresist for device fabrication. By this way, we obtain many assembled configurations, such as aligned Te nanowire or nanospring arrays, crossed multi-walled carbonnanotube (MWCNT) networks, and uniformly distributed graphene oxide (GO) sheets. These assembled arrays and GO sheets have been directly fabricated into photo-detectors, gas sensors (NO_2) or silicon solar cells with high performance.

Furthermore, PMMA can act as solid carbon source for graphene growth. So we combined blown bubble method with thermal annealing, and utilized the PMMA bubble film to grow graphene *in situ* among the assembled MWCNT networks or wrapped on the surface of the Cu nanowires, resulting in MWCNT-graphene hybrid films and aligned graphene nanotubes partially filled by Cu NWs, respectively. The hybrid structures integrate the advantages of both materials with enabled electrical conductivity, structural integrity, and enhanced chemical stability.

In conclusion, our blown bubble method achieves efficient assembly of both one- and two-dimensional nanomaterials over large area, and offers a strategy to produce a variety of graphene-related hybrid structures. It is possible to co-assemble one- and two- dimensional nanomaterials simultaneously and enable broad applications with future.

Self-introduction

Shi-ting Wu received her B. S. degree in Chemistry Materials from Central South University, China, in 2012. She is a current Ph. D. candidate in Material Science and Engineering at college of engineering in Peking University, China. Her research interest focuses on the assembly of both 1-dimensional and 2-dimesional nanomaterials by a blown bubble method, and fabrication of electronic devices based on the assembled nanomaterials.

Label free biosensor based on all semiconducting horizontally aligned carbon nanotube array

Mengmeng Xiao[1], Donglai Zhong[1], Zhiyong Zhang[1], Lianmao Peng[1]

[1] Key Laboratory for the Physics and Chemistry of Nanodevices and Department of Electronics, Peking University, Beijing 100871, China

mmxiao@pku.edu.cn

Single-walled carbon nanotube (CNT) is a promising material in next generation highly sensitive label free FET based biosensors for its ultra-high surface-to-volume ratio, carrier mobility and unique chiral dependent electrical transport properties. Past devices were mostly based on randomly distributed single tubes and networks, which will suffer from the difficulty of identifying the semiconducting tubes and the screening effect tube to tube in networks. We present here a label free protein biosensors based on a field effect transistor (FET) consisting of all semiconducting horizontally aligned CNTs film synthesized by an improved thermoscapillary flow method[1]. The CNT FET biosensor exhibited high sensitivity and fast response to biomolecules. Real-time detection of BSA gave a detection range from 1ng/ml(15pM)-100ug/ml. The lowest detection concentration in our test is at least 15pM with a decreasing in conductance by ~60%. The absorption process can be well fitted with Langmuir isotherms and the affinity equilibrium (or dissociation) constant (K_D) of the antibody-(BSA) pair is extracted to be 837pg/ml. Our method demonstrates the possibility to fabricate highly sensitive semiconducting CNT FET biosensors in large scale.

References:

[1]. Xu, X., et al., Direct current injection and thermocapillary flow for purification of aligned arrays of single-walled carbon nanotubes. Journal of Applied Physics, 2015. 117(13): p. 134303 (6 pp.)-134303 (6 pp.)

Self-introduction

My name is Mengmeng Xiao. I was born in Henan Province on June 28, 1991. Now I'm in my third year as a PHD candidate in Peking University. I like reading, running and playing Ping-Pong in my spare time. My research interest includes carbon nanomaterial growth and their application in sensor area such as bio-sensing and gas sensing.

Chemical Vapor Deposition Synthesis of near Zigzag Single-walled Carbon Nanotubes with Stable Tube-Catalyst Interface

Qiuchen Zhao[1], Ziwei Xu[2], Feng Ding[2,*], Jin Zhang[1,*]

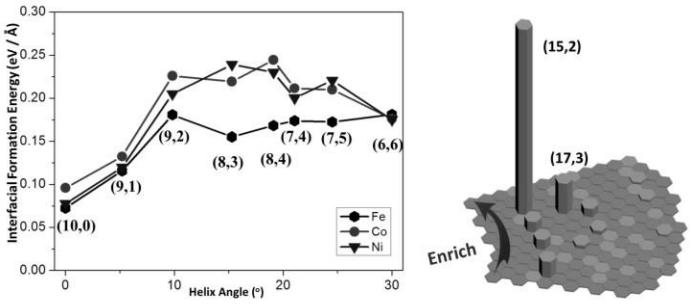
[1] Center for Nanochemistry, College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, China.

[2] Institute of Textiles and Clothing, Hong Kong Polytechnic University, Hong Kong S.A.R., China.

E-mail: zhaoqc-cnc@pku.edu.cn

Chemical vapor deposition (CVD) growth is regarded as the most promising method for realizing structure-specific single-walled carbon nanotube (SWNT) growth. In the past 20 years, many efforts dedicated to chirality-selective SWNT growth using various strategies have been reported. However, normal CVD growth under a constant condition could not take full advantage to optimize the chirality because the randomly formed cap structure allows the nucleation of all types of SWNTs and the chirality of a SWNT is unlikely to be changed during the following elongation process.

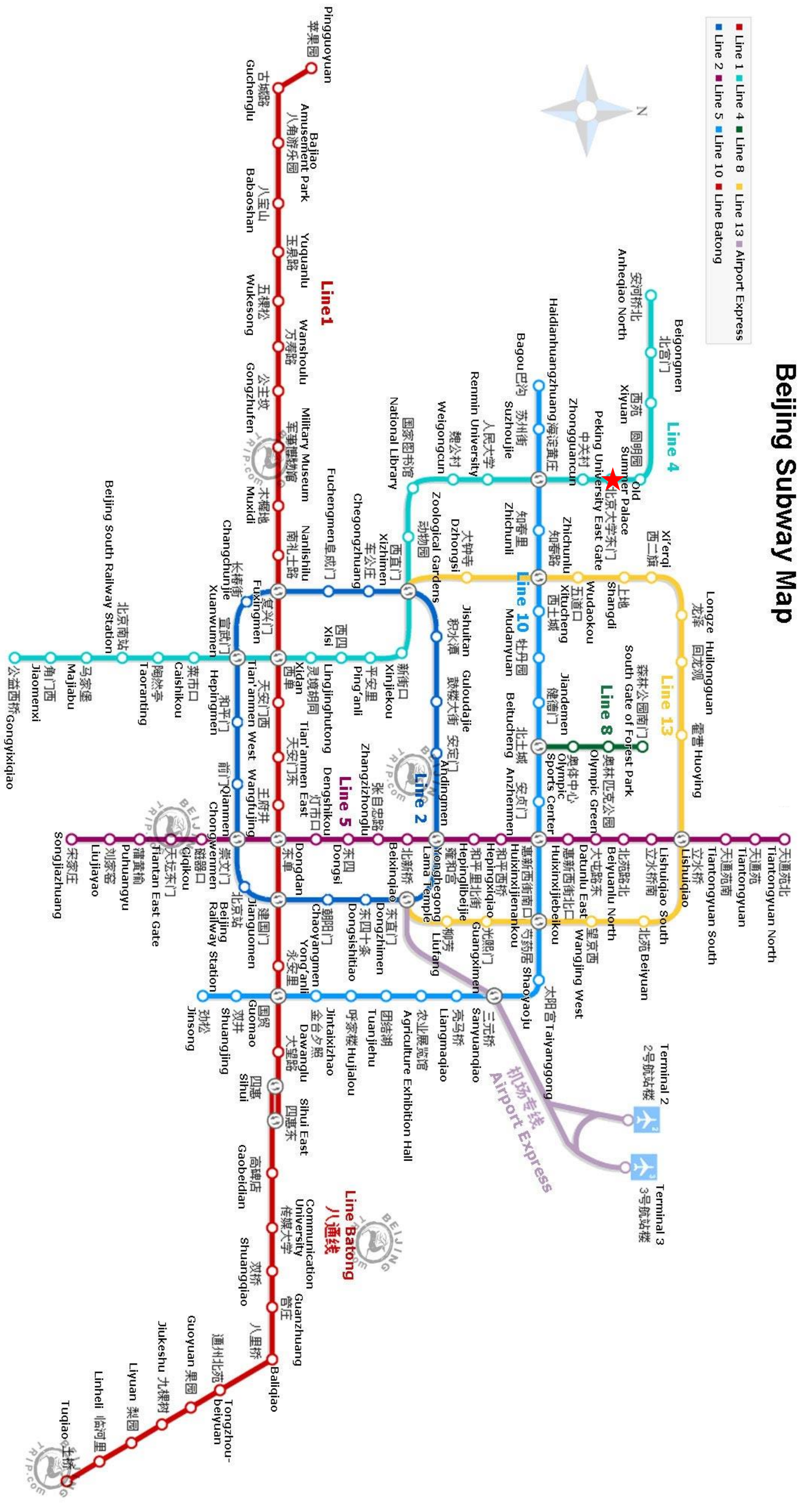
Here, we report a new CVD process that allows temperature to be changed periodically to vary a SWNT's chirality multiple times during elongation in order to build up the energetically preferred SWNT-catalyst interface. With this strategy, SWNTs with small helix angles (less than 10^{o}), which are predicted to have lower interfacial formation energy than others, are enriched up to ~ 72%. Kinetic analysis of the process suggests a multiple re-distribution feature whereby a large chiral angle SWNT tends to reach the near zigzag chirality step by step with a small chiral angle change each step, and hence we named this method "Tandem-Plate CVD". This method opens a new door to synthesizing chirality selective SWNTs by rational catalyst design.



Qiuchen Zhao was born in 1990 in Jilin City, Jilin Province. He received his B.S. from Peking University in 2013 and now working on a 5-year PhD program in the same group. He is now focusing on researching the mechanism of carbon nanotube growth mechanism by in-situ observation methods. Badminton, swimming, animation and paper crafts are his hobbies in extracurricular time.

Map of PKU

★ **CCME,A block.**


Beijing Subway Map
Line 1
Line 4
Line 8
Line 13
Airport Express
Line 2
Line 5
Line 10
Line Batong
Line1
Line 2
Line 4
Line 5
Line 8
Line 10
Line 13
Line Batong 八通线
机场专线 Airport Express
Terminal 2 2号航站楼
Terminal 3 3号航站楼