IBS Center for Multidimensional Carbon Materials

Tuesday Colloquium

Prof. Maoshuai HE

Visiting Research Fellow of the IBS CMCM
School of Materials Science and Engineering
Shandong University of Science and Technology

maoshuai.he@sdust.edu.cn

Towards Chirality-Selective Synthesis of Single-Walled Carbon Nanotubes by Chemical Vapor Deposition

MAY 23
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Bldg. 101
Seminar room on the 1st floor

Single-walled carbon nanotubes (SWNTs) have attracted much attention because of their superb structure and extraordinary properties. However, the structural inhomogeneity of SWNTs is the major hurdle for their practical applications in nanoelectronics. Although great efforts have been devoted to post-synthesis separation of SWNTs, catalytic chemical vapor deposition (CVD) remains the most promising approach for synthesizing SWNTs with specific chirality. In this talk, we will not only explore SWNT growth mechanisms, but also develop catalyst systems suitable for chirality-selective synthesis of SWNTs. The following topics will be addressed:

a. The structures of SWNTs and techniques applied to evaluate the chiralities of SWNTs. The nanobeam electron diffraction technique, a complementary means to optical techniques and can unambiguously assign SWNT chirality, will be highlighted [1-5].

b. Key parameters involved in CVD process and how do the parameters affect SWNT chirality distribution. The chiralities of SWNTs could be modulated by the factors, such as temperature, pressure, carbon source and catalysts, providing the possibility of tuning SWNT chirality distributions by regulating growth conditions [6-8].

c. A series of catalysts systems developed for chiral-selective synthesis of SWNTs [9-12]. Both monometallic catalysts and bimetallic catalysts, including Co, Ni, Fe, FeCu, FeMn, CoCu, supported by either porous SiO2 or MgO, can afford the synthesis of SWNTs with high chirality selectivities.

d. Insights into SWNT growth mechanisms by combining in situ techniques with theoretical calculations. On the basis of environmental transmission electron microscopy characterizations [1, 2, 8, 13] and simulation works [3, 14], the importance of carbon solubility inside metal catalyst for nucleating and growing SWNTs will be elucidated.

References:

[1] Chem. Mater., 24 (2012) 1796-1801. [2] Sci. Rep., 3 (2013) 1460. [3] Carbon, 113 (2017) 231-236. [4] ACS Nano, 8 (2014) 9657-9663. [5] J. Phys. Chem. C, 114 (2010) 13540-13545. [6] Nanoscale, 4 (2012) 7394-7398. [7] Nanoscale, 5 (2013) 10200-10202. [8] Carbon, 107 (2016) 865-871. [9] J. Am. Chem. Soc., 132 (2010) 13994-13996. [10] Carbon, 50 (2012) 4294-4297. [11] Carbon, 108 (2016) 521-528. [12] Nano Res., 4 (2011) 334-342. [13] Carbon, 110 (2016) 243-248. [14] Nanoscale, 7 (2015) 20284-20289.

You are cordially invited to attend!