東京大学大学院工学系研究科専攻間横断型教育プログラム
「機械システム・イノベーション」

東京大学 THE UNIVERSITY OF TOKYO

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第146回公開セミナー/第55回実践リーダーレクチャー

FLOATING CATALYST CVD SYNTHESIS OF SWNTs – LESSONS LEARNED AND FUTURE DIRECTIONS

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会　場:　東京大学工学部2号館3F 31A会議室

要旨

We discuss (n,m) distributions of our floating catalyst chemical vapor deposition (FFCVD) synthesis of SWCNTs from CO using Fe catalyst clusters made via direct evaporation using hot wire generator as well as via thermal decomposition of ferrocene, and with the addition of trace amounts for CO2 and water vapor. Here both the tube diameter as well as length can be tailored by changing the reactor temperature profile as well as CO2 concentration. Chiral i.e. (n,m) distribution as determined with ED/TEM is biased towards large chiral angles with the maximum population at about 23 degrees. Then we proceed to explore the effect of carbon source gas, by adding C2H4 together with CO and looking at the effect of temperature when producing catalysts via ferrocene decomposition.

We review our earlier results when growing SWNTs from CO with Fe catalyst clusters made via physical vapor deposition (PVD) i.e. evaporation via resistively heating the iron wire. To explore in more detail the effect of Fe catalyst cluster size and concentration in the floating catalyst synthesis, we have developed a novel catalyst particle production method via PVD, based on arc discharge between two electrodes i.e. the spark generator. This method allows to control separately both the catalyst particle size and concentration when fed into the floating catalyst SWCNT synthesis reactor. Controlling the catalyst gas phase concentration allows us to reduce significantly tube-to-tube collisions i.e. bundling. Preliminary results show that when reducing catalyst particle gas phase number concentration, the bundle size of the produced tubes also is reduced, and we reduce the tube diameter below 1 nm and narrow the chiral angle distribution towards armchair when reducing synthesis temperature and CO concentration. Interestingly, the SWNT mean diameter does not significantly change when controlling catalyst number mean diameter from 4 nm to 10 nm. We explore also bundle formation during the SWNT deposition processes.

We present the current status of transparent conducting films and field effect thin film transistors manufactured by direct, dry deposition of SWNT networks.

主催:　東京大学大学院工学系研究科「機械システム・イノベーション」プログラム
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