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Carbon nanotubes from diamond

～Attempt at massive growth at low-cost and structural control～

NTT

Motivation

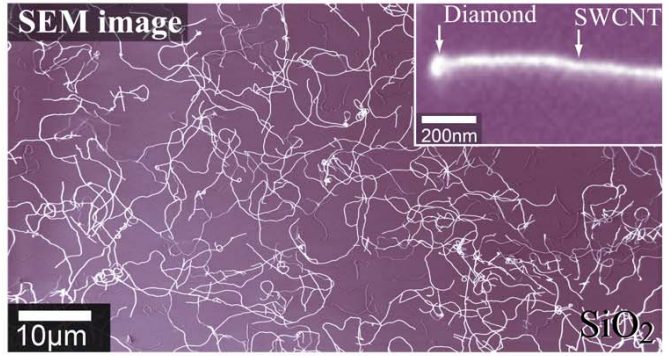
Iron, rare metals (Co and Ni), and noble metals (Au, Ag and Pt) have been used as catalysts for single-wall carbon nanotube (SWCNT) synthesis. There are some issues in SWCNT growth from these catalyst particles. At the SWCNT growth temperature, metal catalyst particles are easily inactivated by aggregation and fusion of particles or by reactions between the catalyst and substrate. Additionally, since these metal particles take the liquid phase during SWCNT growth, structural control of SWCNTs is difficult. Against this background, the development of SWCNT synthetic technology that can resolve the above issues is desired.

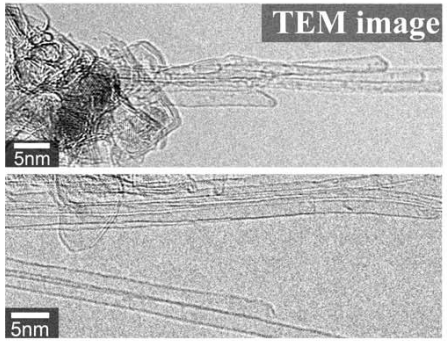
Originality

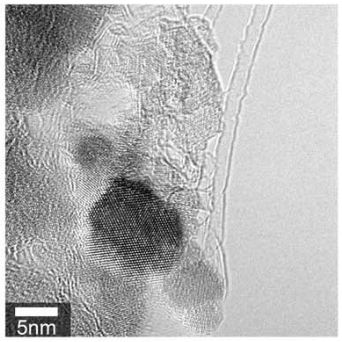
We achieved the first ever SWCNT growth from diamond, allotrope of carbon. Using diamond particles of nanometer size and cleaning the diamond particle surface are key points for SWCNT growth from diamond. Diamond, which consists of three-dimensional covalent bonds of carbon, can maintain the solid phase at the SWCNT growth temperature. SWCNT growth from solid particles is incompatible with the traditional growth mechanism and is a quite novel phenomenon.

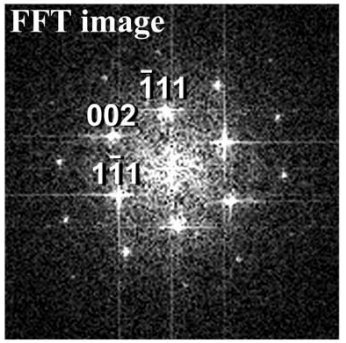
Impact

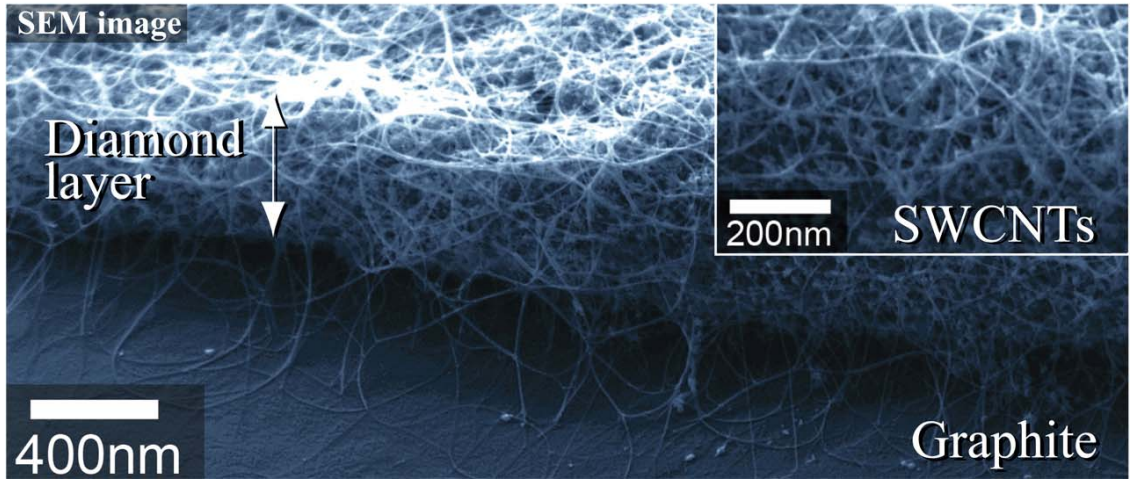
Diamond particles can be produced at low cost, and their catalysis activity for SWCNT growth is as high as that of the metal catalyst particles. This leads to low-cost SWCNT synthesis that does not rely on the use of rare and noble metals. Additionally, diamond nanoparticles have certain characteristics that metal particles do not: at the SWCNT growth temperature, they do not fuse with each other, have low reactivity with various substrate materials, and can maintain the solid phase. With these unique features, diamond could replace metals for SWCNT growth and make precise structural control of SWCNTs possible.











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