

The Role of Catalytic Nano-particles in Nano-Carbon Technology

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Single walled carbon nanotubes (SCNTs) are generated consistently in chemical vapor deposition method by using appropriate nano-sized metal particles as nucleation sites for the tubule growth. Under controlled conditions we have demonstrated that SCNTs can grow vertically on a silicon substrate with several millimeters height. A key factor here was to control precisely small amount of water in the reaction gas during the growth. The method is available for making patterned growth on a substrate. Some of our recent results will be presented with emphasis on providing the samples including fabricated ones upon request (Fig. 1)[1].

Traditionally, catalyst particles are examined with HRTEM and STEM with EELS spectroscopy. Platinum particles supported on carbon are one of key materials for the development of fuel cell electrodes. One of examples of HRTEM observation on Pt particles will be discussed [2]. Here we introduce the recent development of characterization of such particles in terms of energy filtered imaging of metal particles. They were placed at specially prepared surfaces of CNTs and also their hollow inside. The result demonstrates that our technique enables to image individual metal particles as small as a single atom. It will be emphasized here that the success is to use nano-spaces of single-walled nanotubes as supporting containers for metal particles. The tubes provide with noiseless film for TEM observations (Fig. 2) [3].

Lastly, I will present the way to store nano-particles in the hollows of nanotubes. This study is aimed at developing a carrier for drug delivery systems. We have tested inserting or doping C60 molecules into nanocarbon materials, namely carbon nanohorns, which is similar to SCNTs. The doping was carried out in solution instead of conventional vapor phase that is not applicable to drugs [4]. We have confirmed that after oxidizing properly as-grown carbon nanohorns, we doped them with C60 and examined adsorption and release characteristics of them. The experiment has been applied to one of real drugs, Dexamethasone, and confirmed that the dopant drugs were stored inside the tubes and released under certain conditions [5].

References

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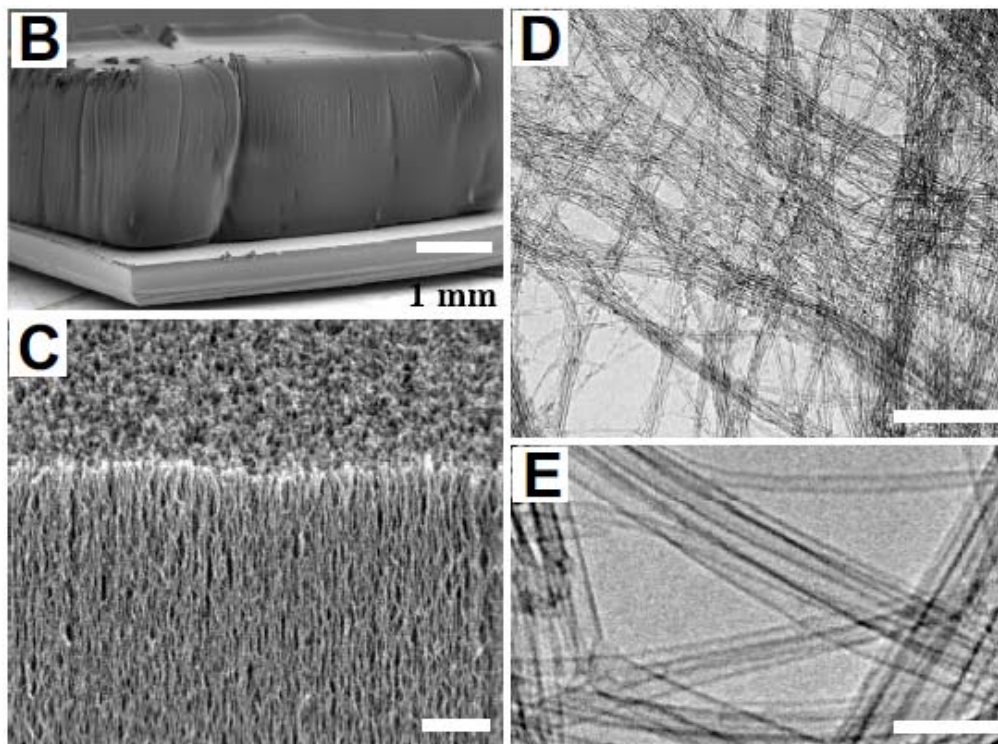


Fig. 10 CVD grown single walled carbon nanotubes with 3 mm high on a Si substrate.

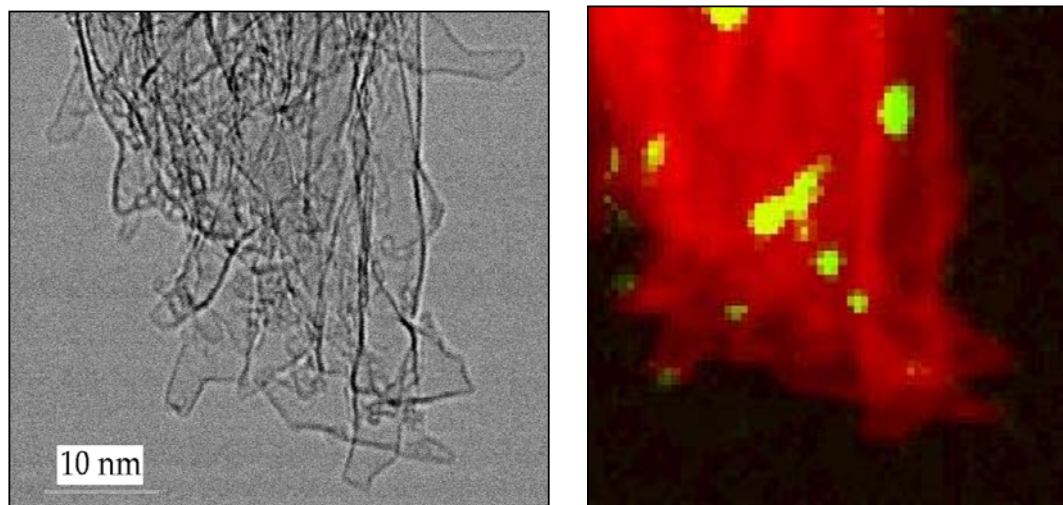


Fig.20 Energy filtered images of carbon nanohorns with Gd clusters. The weakest yellow dots correspond to individual single Gd atoms.