Morphological Control of Aerosol Carbon Nanotubes

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In this paper, we demonstrate a new method for selectively growing aerosol carbon nanotubes (CNTs) with different shapes by precisely controlling the catalytic particle size and reacting temperatures. The growth of aerosol CNTs in this study was made by the combination of spray pyrolysis of bimetallic nanoparticles and thermal CVD processes, in which the mixture of Ni guest and Al host particles with the wetting angle of 169^{o} on graphite surface was first formed and subsequently reacted with acetylene gas.

As the result of a series of experiments, we observed that sea urchin-like CNTs were formed at less than 700^{o}C, while the mixture of sea urchin- and coil-typed CNTs were formed at 700-900^{o}C. On the basis of SEM analysis for the mixture of sea urchin- and coil-typed CNTs, we proposed that the diameter of seeded particles played a key role in growing different shaped CNTs. In order to identify the role of particle size, the several groups of spray pyrolyzed and size-selected metallic nanoparticles with 100, 200, and 300 nm were produced by a differential mobility analyzer, and then they were subsequently introduced into the thermal CVD process to continuously grow aerosol CNTs. As the result, we observed that coil-typed CNTs were mostly grown on the surface of seeded metallic particles with less than 100 nm. This indicates that the growth temperature and seeded particle size are key factors to tailor the morphology of aerosol CNTs in the gas phase.

References

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