Synthesis and properties of single-walled carbon nanotubes co-axially wrapped with mono- and few-layer BN nanotubes

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We propose a conceptually new structure, in which mono- or few BN layers seamlessly wrap around a single-walled carbon nanotube (SWNT), and result in an atomically smooth coaxial tube consisting two different materials, as shown in Figure 1. The structure is synthesized by chemical vapor deposition (CVD). As the reaction occurs on outer surface of the existing SWNTs, we name this process conformal CVD. Various SWNTs, e.g. vertically aligned array, horizontally aligned arrays, suspended SWNTs, random network and films, are employed as the starting material, and successful coating are achieved on all of them. Our characterizations confirm that the outside BN coating started locally on the wall of a SWNT and then merge into a BN nanotube on the curved surface of the SWNT which served as a template. The number of walls can be tuned from 1 to a few by controlling the CVD condition. The structure of inside SWNTs are almost not effected by the conformal CVD, as evidenced by Raman and many other characterizations. The crystallization and cleanness of the starting SWNT template are believed to be critical for the successful fabrication of outside walls. This structure is expected to have a broad interest and impact in many fields, which include but not limited in investigating the intrinsic optical properties of environment-isolated SWNTs, fabricating BN-protected or gated SWNT devices, and building more sophisticated 1D material systems.

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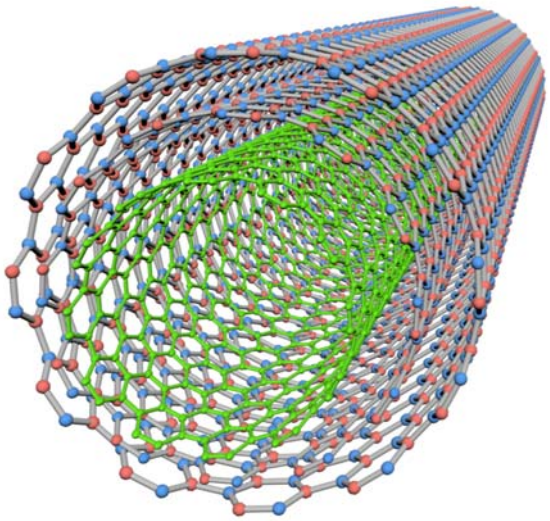

Fig.1 Schematic structure of an SWNT wrapped with a bilayer BN nanotube.