다중벽 탄소나노튜브의 기계적 절단 및 화학적 기능화
Mechanical Cutting and Chemical Functionalization of Multi-walled Carbon Nanotubes

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Uniform and stable dispersion of carbon nanotubes (CNTs) in various solvents is considered to be prerequisite to their extensive applications, particularly when they are produced in powder forms. This study investigated dispersion, in organic solvents, of multi-walled CNTs milled with a homogenizer and a high-power ultrasonicator After mechanically shortening the length of MWNTs, they were reacted in a mild (3 M) nitric acid and then functionalized with octadecyl amine (ODA) or hexadecyl amine (HDA) A successive use of a homogenizer and a high-power ultrasonicator was very effective in cutting long entangled CNTs The subsequent treatment with a nitric acid introduced a large number of defects to the tips or the walls of CNTs This process frequently damaged CNTs mainly by tip opening or body breaking, giving rise to production of many nanoparticles The acidic treatment brought carboxyl groups to the defects of CNTs, which would act as active sites for further chemical functionalization. The HDA and ODA functional groups were covalently introduced to these sites of carboxylated CNTs by chemical reactions Nanoparticles also functionalized with organic groups were effectively extracted out during repeated solvent washing which was originally applied to remove excessive free organics Our functionalized CNTs showed a good dispersion in non-polar solvents The functionalized CNTs were structurally and chemically characterized using various microscopic or spectroscopic methods.