DNA-Mediated Copper Nanoparticle Formation on Dispersed Single-Walled Carbon Nanotubes

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A new and facile method for the preparation of single-walled carbon nanotubes (SWCNTs) decorated with Cu nanoparticles (CuNPs) formed on a double-stranded DNA template in aqueous solution has been developed. A specially designed synthetic DNA sequence, containing a single-stranded domain for the dispersion of carbon nanotubes and double-stranded domains for the selective growth of CuNPs, was utilized. The final SWCNT/CuNP hybrids were characterized using fluorescence spectroscopy and transmission electron microscopy. The analyses clearly demonstrated the selective formation of uniform CuNPs on the carbon nanotube scaffold.

Introduction. – Novel 1D single-walled carbon nanotubes (SWCNTs)/nanoparticle hybrid materials, in which SWCNTs are often used as scaffolds for the assembly of nanoparticles, are of great importance due to their considerable hardness and toughness [1]. SWCNT/metal nanoparticle hybrids, especially transition metal nanoparticle-decorated SWCNTs, have aroused great interest because of their vast applications in sensor devices [2], photoelectrochemical cells [3], as catalytic supporters [4], and in surface-enhanced *Raman* spectroscopy [5]. Controlled decoration of SWCNTs with metal nanoparticles modifies their electronic structure resulting in better electroanalytical performance due to the synergetic effect of the two materials compared to bare metal nanoparticles [6], making important not only fundamental studies of the interactions between the carbon matrix and the metallic nanoparticles, but also the aspects of their broad potential applications.

Currently, various methods are being explored, generally being divided into covalent or noncovalent attachment of certain metal nanoparticles onto carbon nanotubes [7–12]. Covalent deposition requires prefunctionalization of the nanotubes by modifying their surface. In many cases, it involves acid treatment to create COOH, C=O, or OH groups for subsequent anchoring of metal nanoparticles [8]. The harsh acidic treatment of SWCNTs may introduce many extensive defects in the sidewall, thus considerably perturbing the mechanical and electronic performance of the tubes. On the other hand, the noncovalent approach maintains the properties of the nanotube, the carbon scaffold being minimally perturbed by utilizing functional compounds, such as organic molecules [9], polyelectrolytes [10], and single-stranded DNA (ssDNA)