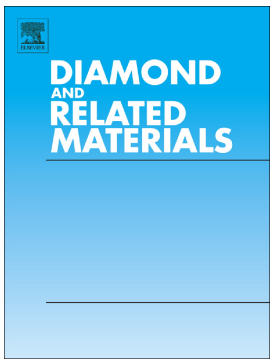

Conductivity and field emission enhancement of C60-encapsulated single-walled carbon nanotubes

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Conductivity and field emission enhancement of C_{60}-encapsulated single-walled carbon nanotubes

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Keywords: single-walled carbon nanotube, fullerene, fullerene peapod, charge transfer, Fermi level, field-emission, tunneling

Abstract

C_{60} molecules are encapsulated inside single-walled carbon nanotubes (SWNTs) and resulting charge (electron) transfer from the SWNTs to the C_{60}s are observed. A Raman upshift in the G-band for the C_{60}-encapsulated SWNTs (C_{60}@SWNTs) is indicative of a charge transfer occurred in this system. The observed conductivity enhancements strongly support the p-doping of the SWNTs by C_{60} encapsulation, implying the electron concentration of the SWNTs is reduced by the insertion of C_{60}. We also observe the significant field emission (FE) enhancement of C_{60}@SWNTs, which is not expected since the reduced electron concentration of SWNTs is typically to induce a Fermi level downshift. However, ultraviolet photoelectron spectroscopy results show that C_{60} encapsulation induce a Fermi level upshift (i.e. reduced work function). Although the p-doping of SWNT is achieved by C_{60} encapsulation, the reduced work function of C_{60}@SWNTs provide the electrons a higher probability for tunneling, resulting in both FE and conductivity enhancement.