Transparent and Highly Conductive Carbon Nanotube Thin Films

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Layer-by-layer assembly was used to generate transparent, highly conductive thin films containing carbon nanotubes. Three different types of nanotubes were used: (1) multi-walled carbon nanotubes (MWNTs), (2) a mixture of single, di- and tri-walled nanotubes and (3) purified HiPCO single-walled carbon nanotubes (SWNTs). Thin films, less than 100 nm thick, were created by alternately exposing glass slides to aqueous suspensions of nanotubes stabilized by deoxycholate and a solution of poly(diallyldimethylammonium chloride) (PDDA). SWNTs produced the most transparent (> 85% transmittance throughout the whole visible light spectrum) and electrically conductive (~ 150 S/cm) 20-bilayer films, with a thickness of just 42 nm. This study demonstrates the ability to produce highly transparent and conductive nanotube-based thin films, which are potentially useful for anti-static films. Films with sheet resistance below 1kΩ/sq are possible following heating these films to 300 ℃ for five minutes, which results in densification and removal of insulating binder. This level of conductivity, approaching 1000 S/cm, is potentially useful as a flexible ITO replacement.

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