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Spinning Multi Walled Carbon Nanotubes and Flexible Transparent Sheet Film

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We investigated a flexible transparent film using the spinning multi-walled carbon nanotubes (MWCNTs). Spin-capable MWCNTs on iron catalyzed on a SiO2 wafer was grown by chemical vapor deposition, which was performed at 780°C using C2H2 and H2 gas. The average diameter and length of MWCNTs grown on the substrate were ~15 nm and 250~300 μm, respectively. The MWCNT sheets were produced by continuously pulling out from well-aligned MWCNTs on a substrate. The MWCNT sheet films were produced simply by direct coating on the flexible film or grass. The thickness of sheet film was remarkably decreased by alcohol spraying on the surface of sheet. The alcohol splay increased transmittance and decreased electrical resistance of MWCNT sheet films. Single and double sheets were produced with sheet resistance of ~699 and ~349 Ω/sq, respectively, transmittance of 81~85 % and 67~72%, respectively. The MWCNT sheet films were heated through the application of direct current power. The flexible transparent heaters showed a rapid thermal response and uniform distribution of temperature. In addition, MWCNT yarns were prepared by spinning a bundle of MWCNTs from vertically super-aligned MWCNTs on a substrate, and field emission from the tip and side of the yarns was induced in a scanning electron microscope. We found that the field emission behavior from the tip of the yarn was better than the field emission from the side. The field emission turn-on voltages from the tip and side of MWCNT yarns were 1.6 and 1.7 V/μm, respectively, after the yarn was subjected to an aging process. Both the configuration of the tip end and the body of the yarn were changed remarkably during the field emission. We also performed the field emission of the sheet films. The sheet films showed the turn on voltage of ~1.45 V/μm during the field emission.

Keywords: carbon nanotubes, spinning, flexible transparent film