Synthesis and Thermophysical Properties of Vertically Aligned SWNT-PMMA

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SWNT-composites have not been fully exploited and may offer exciting opportunities for new composites because of unique properties of SWNTs. We present the simple experimental method of synthesizing uniformly-distributed and vertically-aligned SWNTs (VA-SWNTs) -polymethyl methacrylate (PMMA) composite. This simple synthesis may be applied with other polymers. VA-SWNTs were grown on quartz substrates using the alcohol catalytic CVD process. VA-SWNT-PMMA film was synthesized by polymerizing PMMA-sonicated toluene in which aligned SWNTs were immersed. Conventional SWNT-PMMA films were processed using polymerizing monomer MMA in which SWNTs were infiltrated.

The weight fraction of SWNT-composites was estimated to be 0.5%. The kinetics of oxidative thermal degradation of PMMA from composites were delayed by SWNTs. The thermal degradation of composites having different degrees of nanotube dispersion was also compared. PMMA and poorly aligned SWNT-PMMA showed the lower thermal stability than PMMA from VA-SWNT-PMMA because well dispersed SWNTs into PMMA have larger surface areas. Thermal conductivities of PMMA and VA-SWNT-PMMA samples coated with Au were measured by photothermal radiometry. The estimated thermal conductivity of the pure PMMA sample fitted well with simulation results. However, the photothermal behavior of the SWNT-PMMA sample is quite unique suggesting that the anisotropy of thermal conductivity due to aligned SWNTs in PMMA.