Effect of Length and Shape of MWCNT on the Thermal and Electrical Properties of MWCNT Mat and Bucky Paper

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We highlight the effect that mesoscopic shape of individual multi-walled carbon nanotubes (MWCNTs) has on their collective thermal properties when they are lumped together into MWCNT assemblages. The thermal properties depend both on the mesoscopic shape of the MWCNTs and on the structure of the assemblage. The mesoscopic shape is represented by static bending persistence length (l_{sp}) and the assemblage structure is represented by network length (l_e). It is demonstrated that various thermal properties depend on $n^*=2l_{sp}/l_e$. The variable thermal properties are linear thermal expansivity, thermal diffusivity, specific heat capacity, and thermal conductivity. In the case of $n^*>1$, the MWCNT assemblages contract with increasing temperature. On the contrary, in the case of $n^*<1$, the assemblages expand with increasing temperature. The apparent thermal conductivity decreases linearly with increasing n^*.