Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Self-similar mechanics of vertically aligned carbon nanotube organization MICHAEL DE VOLDER, SAMEH TAWFICK, DANIEL VIDAUD, A. JOHN HART, University of Michigan — It is well-known that carbon nanotube (CNT) growth from a dense arrangement of catalyst nanoparticles creates a self-organized vertically aligned CNT "forest" that offers attractive anisotropic mechanical, thermal, and electrical properties. Self-organization is governed by the CNT diameter and spacing, and the surface interactions between contacting CNTs. We demonstrate that arrays of CNT microstructures having micron-scale diameter organize in a similar manner as individual CNTs within a forest. For example, as postulated for CNT forests, entanglement of CNT microstructures during the initial stage of growth creates a self-supporting network, and this enables coordinated subsequent growth of the structures in the vertical direction. The alignment of these self-similar CNT forests is inversely related to the spacing of the microstructures, and like individual CNTs, widely-spaced microstructures that are not self-supporting fail to organize into an oriented superstructure. The growth rate and final forest height also depend on these geometric conditions, suggesting that mechanical interactions affect the collective progression and termination of a CNT film. This study and method offers new insights into the self-organization of one-dimensional nanostructures, and coordinated assembly of CNT microstructures offers opportunity for engineering energy-absorbing foams and photonic crystals.

A. John Hart
University of Michigan

Date submitted: 30 Nov 2008 Electronic form version 1.4