Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Insulator-to-conductor transition in liquid crystal-carbon nanotube nanocomposites RAJRATAN BASU, ALFRED GARVEY, US Naval Academy — A small quantity of carbon nanotubes (CNTs) was dispersed in a liquid crystal (LC) and the LC+CNT hybrid in the isotropic phase was found to exhibit an insulator-to-conductor transition when an external electric field was applied. This effect was probed by measuring the resistance of the system as a function of applied voltage across the LC cell. In an LC+CNT hybrid, the LC molecules self-assemble themselves at the CNT surface due to $\pi-\pi$ electron stacking, creating pseudonematic domains (PNDs) surrounding the CNTs. These CNT-embedded PNDs interact with the external electric field even in the isotropic phase of the LC. When the external field is applied, the PND-encapsulated CNTs start to rotate along the field and form wires due to their natural tendency of entanglement. The CNT-wires eventually short the two electrodes of the LC cell, manifesting an insulator-to-conductor transition in the LC+CNT hybrid. Additional studies revealed that the cell spacing and the CNT-concentration had a significant impact on the threshold voltage across the LC cell for the insulator-to-conductor transition process.

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Date submitted: 24 Oct 2016 Electronic form version 1.4