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Aging Effects on a Conductive Carbon Nanotube Latex Nanocomposite Film

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The aging effects of three environmental conditions on a conductive carbon nanotube (CNT) filled latex film are presented. Resistivity measurements collected over a multi-week time period for three samples in the three environmental conditions (-55 °C, 25 °C, and 80 °C) are reported and analyzed. We have identified a correlation between environmental conditions and the effect on electrical properties of the nanocomposite.

Monitoring changes in the electronic properties of CNT-filled polymers in cold, room, and hot environments has the potential to reveal not only the variations of conductivity as a function of environmental exposure but also elucidate the fundamental mechanisms that give rise to these changes. Such environmental sensitivities have strong implications for the final design of any application using these CNT-filled polymers. Current passing through a polymeric based substrate with nano-conductive pathways has its own inherent issues associated with the potential anisotropy of the flow characteristics as well as localized heating and long term polymer degradation and creep. In addition, CNT migration, CNT to CNT contact degradation, change in overall resistivity over time, and aggregation of CNTs are of interest. The presence of aggressive thermal environments, adds an additional complexity to the functional performance of the material. However, these are conditions that most engineered products must be able to withstand for long periods of time with reliability and confidence.

In this investigation, a water-based latex solution doped with multi-wall CNTs has been applied with stencil masked spray deposition to the surface of a non-conductive manufactured substrate. Four-point probe resistivity measurements were conducted via electrodes deposited across the width of the latex film on the top surface via brush application. We have identified both long term and short-term temperature-dependent resistivity trends. Our presentation will highlight these phenomena and provide explanations for the underlying mechanisms.