NANO HIGHLIGHT

SNM: Roll-to-Roll Manufacturing of High Quality Bucky-tape with Aligned and Crosslinked Carbon Nanotubes Through In-line Sensing and Control

NSF Grant 01344672
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This project focuses on establishing a fundamental understanding of rapidly producing rolls of buckypaper, which are thin sheets of carbon nanotubes, with high quality consistency and high performance for potential scaled-up industrial applications. The joint research team from Florida State University and Georgia Tech are working on four major aspects: 1) develop a rapid roll-to-roll manufacturing process utilizing the self-repelling effects of selected flow media; 2) investigate in-situ chemical functionalization that can rapidly, covalently interconnect CNTs to improve load transfer and thermal and electronic transport properties of CNT networks; 3) explore in-line multiple-stage stretching of the interconnected CNT networks that could orient the randomly dispersed CNT networks into specific patterns to improve mechanical properties and optimize transport properties, and 4) explore novel in-line Raman spectrum monitoring and multistage process models to provide essential and affordable closed loop quality control and variation reduction methods for achieving a high quality consistency in the nanomanufacturing process. Integrated prototypes will be studied and developed to demonstrate the continuous roll-to-roll process to manufacture strong and continuous CNT tapes with high electrical and thermal conductivity at a low manufacturing cost, and are ready for industrial product development studies.

Recently, the team studied and established the manufacturing process and successfully produced and delivered a continuous roll-to-roll buckypaper sample of 6-in wide × 200-ft long with 5 gram/m^2 (5 GSM) ultra-lightweight aerial density to an industrial partner for new product prototype development. We explored an unique in-situ integrated dynamic light scattering (DLS) and UV-vis-NIR spectrum measurements into continuous sonication processes for the first time to achieve in-line monitoring and quantifying dispersion quality and efficiency, which are essential for many scale-up manufacturing processes. The research team also investigated the effectiveness of using a generalized wavelet shrinkage method to obtain in-line Raman spectroscopy measurements for quality monitoring of produced buckypaper materials. A US patent application was filed based on the technology developed for producing high quality continuous buckypaper materials. The research team is actively providing continuous and high quality sheets of CNT and their hybrid materials to research communities, government agencies and industrial partners through collaborations. Contact: Dr. Richard Liang, zliang@fsu.edu at High-Performance Materials Institute, Florida State University.