Electrospinning Enabled Ultra-Conductive Copper-Carbon Nanotube Composites

Kai Li,[1] Lydia Skolrood,[1] Soydan Ozcan,[1,2] Tolga Aytug[1, *]

[1] Chemical Science Division, Oak Ridge National Laboratory, 1 Bethel Valley Road, Oak Ridge, Tennessee,37831, United States

[2] Department of Mechanical, Aerospace, Biomedical Engineering, University of Tennessee, Knoxville, Tennessee 37996, United States

* Corresponding author: aytugt@ornl.gov

The power losses associated with the electrical resistance of copper (Cu) adversely impacts efficiency and performance of all electric devices. Development of advanced conductors, i.e., ultra-conductive copper (UCC), recently attracted significant attention that can enable increased energy efficiency. Given the unique electrical properties of carbon nanotubes (CNTs), incorporation of CNTs into Cu metal matrix could lead the way to produce UCC materials. In this study, an electrospinning strategy was employed to prepare Cu-CNT composites. Polymer-based solution containing CNTs was electro spun into highly aligned fibers onto copper tapes, followed by thermal treatment to remove organic solvent/polymer from the CNT matrix as well as to achieve an ordered, and uniformly distributed CNT layer on Cu surface. Samples were characterized by scanning electron microscope, Raman spectroscopy, and transmission electron microscopy for microstructural properties. Influence of electrospinning conditions, solvent formulations, and heat treatment protocols on the electrical properties of Cu-CNT composites were thoroughly investigated by four-probe techniques. The results demonstrate improved conductivity and promise the viability of electrospinning approach as a potential method to fabricate UCC composites.