Multiscale Hybrid Composites Reinforced with Interface-controlled Carbon Nanomaterials for Multifunctional Applications

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Carbon nanotubes (CNTs) and graphene have attracted considerable attention in recent years because of their unique physical properties. Due to the extraordinary properties of CNTs and graphene, nanocomposites of higher structural and functional properties compared to the matrix can be obtained with the small amount of additions in the matrix. However, the mechanical properties of nanocomposites are in the range of 10-20% less than those of the fiber reinforced composites. In order to utilize the nanocomposites in the structural and functional applications, it is necessary to develop hybrid composites combined with functional metal nanoparticles (MNPs) as well as micro fibers and nano-carbon materials. Here, the high performance fiber reinforced polymeric composites are reinforced with CNTs and graphene sheets, respectively. Highly dispersed nanocarbon materials were introduced onto the carbon fiber surface *via* electrophoretic deposition (EPD) in order to increase the interfacial strength between fiber and polymer matrix. Furthermore, graphene and carbon nanotube based the hybrid micro/ nanocomposite fibers were fabricated for wide wearable textile electronic applications such as wire typed field effect transistors (FET), electrochemical energy storage and electromagnetic interference (EMI) shielding. The fibers were produced by the wet spinning of the graphene oxide (GO) wetgels. The physical performance of the fibers is easily adjustable by control of the size and orientation of the GO sheets during the fabrication process. The electrical properties were also enhanced by the intercalation of the silver nanoparticles nanoparticles into the graphene layers of the fiber with the solution based in-situ hybridization method. Also we observed that mechanical and electro-magnetic performance of the nanocomposite fibers can be significantly enhanced by incorporation of the permalloy nanoparticle decorated single-walled carbon nanotubes into PVA polymers.

Acknowledgement

This research was supported by a Global Research Lab Program and Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF-2007-00017 and NRF-2015R1C1A1A02037139).

Short Biography

Dr. Byung Sun Kim has been researching at the Composites Research Division (CRD) of Korea Institute of Materials Science (KIMS) since 1991. He is a Professor in Advance Materials Department, Korea University of Science & Technology (UST) since 2012, and, also, is a Professor in Mechanical Engineering, Changwon National University since 2015. Between ’10 and ’16, he was a Director of Global Research Laboratory (GRL) program between CCM of Univ. of Delaware and CRC of KIMS on “Advanced Hybrid Micro/ nanocomposites for Structural and Multifunctional Applications”. He received his Ph.D. from Dept. of Mechanical & Aerospace Engineering from Missouri University of Science & Technology. Between ’00 and ’03, he was a Visiting Scholar at ME Dept., MIT (Massachusetts Institute of Technology). In 2007, he was awarded of Korean Presidential Commendation for excellence in research into the structural design and processing of Composite Materials. He was the president of Korean Society for Composite Materials (2012-2013) and was an Executive Council Member of International Committee on Composite Materials (ICCM) (2013-2015).