

Fabrication Processes and Properties of Carbon Nanomaterials Filled Nanocomposites

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Abstract

Carbon nanomaterials, including graphene and carbon nanotube (CNT), are promising fillers for composite materials to overcome the limitation of traditional reinforcements in composites due to their excellent mechanical and functional properties. In previous researches on carbon nanomaterial filled nanocomposites, limited improvements of properties have been shown because of strong agglomeration of the carbon nanomaterials and poor interfacial bonding between carbon nanomaterials and matrices. In order to solve these important issues, a novel fabrication process, named “molecular level mixing process”, has been developed to fabricate carbon nanomaterials filled nanocomposites in order to maximize the effect of filler addition in various matrices.

The molecular level mixing process to fabricate carbon nanomaterials filled nanocomposite powders is composed of four steps. As a first step, the carbon nanomaterials are functionalized by attaching functional molecular groups on surfaces. Second step is to fabricate a precursor carbon nanomaterial bonded with matrix ions induced by chemical interaction. Third step is to mix the carbon nanomaterial with matrix by nucleation and growth of matrix phase. Fourth step is the synthesis of nanocomposite powders, in which the carbon nanomaterial and matrix phase are homogeneously mixed together.

Homogeneous dispersion of carbon nanomaterials with strong interfacial bonding with matrices have been achieved by molecular level mixing process. Inorganic matrices nanocomposites filled with carbon nanomaterials, such as CNT/Metal, Graphene/Metal, and Graphene/Ceramic, exhibit outstanding mechanical properties including strength, modulus and fracture toughness. Also, wide scope of possible applications as stretchable conductors, electrode for supercapacitors and EMI shielding materials are expected for polymer matrix nanocomposites filled with carbon nanomaterials, such as Graphene/AgNW/PDMS, CNT/Carbon and Graphene/Ni/PMMA nanocomposites. It is suggested that the carbon nanomaterials filled nanocomposites are new emerging materials for multi-functional applications.

Biography:

Prof. Hong completed his Ph.D. in Dept. of Materials Science and Engineering at Northwestern University in 1984. After R&D experience at Stanford University as a research associate, he joined Korea Advanced Institute of Science and Technology (KAIST) as a professor in 1986, where he has been directing research and education on nanocrystalline materials and nanocomposites. Prof. Hong has published 205 international journal papers and registered 140 patents mainly in areas of nanocrystalline materials and nanocomposites.

Prof. Hong had served as a Managing Director of the Office of Strategic R&D Planning (OSP) in the Ministry of Knowledge Economy (MKE), Director for Basic Science and Engineering in National Research Foundation (NRF) of Korea, Presidents of the Korea Society for Composite Materials (KSCM) and the Korean Powder Metallurgy Institute (KPMI), and the Director of KAIST Institute for the NanoCentury (KINC). He currently is acting as members of the Korea Academy of Science and Technology (KAST) and the National Academy of Engineering of Korea (NAEK).