탄소나노재료를 이용한 고분자 복합재료 및 투명전극 제조

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Carbon Nanomaterials for POlymer nanocomposites and Transparent Electrodes

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Carbon nanomaterials (CNs) such as carbon nanotubes (CNTs) and graphene have attracted enormous interest from both academia and industry, since they exhibit remarkable mechanical, electrical, and thermal properties. In particular, exceptional mechanical and electrical properties of CNs render them an ideal reinforcing material for polymer nanocomposites or fabrication of transparent electrodes. However, to fully realize the potential of CNs as a reinforcing agent, two main issues should be resolved: homogeneous dispersion and/or exfoliation of CNs in matrix polymer and good interfacial interaction between CN and matrix polymer. [1] For this purpose, a considerable number of studies on polymer-CN composites have focused on enhancing the compatibility between CN and polymer to achieve homogeneous dispersion of CNs in polymer and efficient load transfer across the polymer-CN interface.

One effective method to enhance the compatibility between CNs and polymer is to directly functionalize the surface of CNs. However, this method inevitably destroy the π-electron system of CNs for introduction of functional groups on the surface of CNs, which results in detrimental effect on electrical and mechanical properties of CNs. Hence, non-covalent functionalization of CNs by use of compatibilizer is advantageous for dispersion of CNs in polymer without damage of CNs. For effective compatibilizer, the following condition must be satisfied: the compatibilizer favorably interacts with both the surface of CNs and matrix polymer.

We have reported synthesis of effective compatibilizers to homogeneously disperse multi-walled carbon nanotubes (MWCNTs) in Polyamide 6 (PA6) [2], poly(styrene-co-acrylonitrile) (SAN) [3,4] and polycarbonate (PC) [5]. For this purpose, the compatibilizers are designed to have strong interaction with both the surface of MWCNTs and the matrix polymer through non-covalent interaction. To satisfy this condition, new compatibilizers composed of polythiophene (PT) backbone and poly(acrylic acid) (PAA), poly(methyl methacrylate) (PMMA) or poly(caprolactone) (PCL) grafts are synthesized. The effect of these new compatibilizers on dispersion of MWCNTs and mechanical and electrical properties of polymer/MWCNT nano-composites is examined as a function of the MWCNT content as added in the polymer.

For poly(ethylene terephthalate) (PET)/ graphene oxide (GO) composites, the GO surface was functionalized by a simple SN2 reaction between GO and alkyl bromide. The functionalized GO was uniformly distributed in PET/GO composites and thus mechanical and barrier properties of the composite were largely improved. [6]

Development of flexible and transparent electrodes is essential for fabrication of flexible organic electronics. For the purpose,

we developed transparent, flexible and highly conductive thin films from single-walled carbon nanotubes [7] and graphene [8] by using a non-ionic surfactant for dispersing the carbon nanomaterials in aqueous or organic solvents, respectively.

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