Exfoliation of Carbon nanomaterials and Its Application to Polymer nanocomposites and Electronics

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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 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. 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 synthesized effective compatibilizers to homogeneously disperse multi-walled carbon nanotubes (MWCNTs) in Polyamide 6, poly(styrene-*co*-acrylonitrile) and polycarbonate. For this purpose, the compatibilizers are designed to have strong interaction with both the surface of MWCNT and the matrix polymer through non-covalent interaction. To satisfy this condition, new compatibilizers composed of polythiophene backbone and poly(acrylic acid), poly(methyl methacrylate) or poly(caprolactone) grafts are synthesized. The effect of these new compatibilizers on dispersion of MWCNTs and mechanical and electrical properties of polymer/MWCNT nanocomposites is examined as a function of the MWCNT content as added in the polymer matrix.

For poly(ethylene terephthalate) (PET)/graphene oxide (GO) composites, the GO surface was functionalized by a simple S_{N2} 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.

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 and graphene by using a non-ionic surfactant for dispersing the carbon nanomaterials in aqueous or organic solvents, respectively.

Room B: Session 1: Nano Materials

13:30~17:30, May 17th, 2013 (Friday)

Chair	**Peter A. Lieberzeit, University of Vienna, Austria**
co-Chair	**Yutao Zhao, Jiangsu University, China**
13:30~13:35	Chairs' introduction
13:35~14:05	**Keynote Lecture:** **Title:** Exfoliation of Carbon nanomaterials and Its Application to Polymer nanocomposites and Electronics Won Ho Jo, Seoul National University, Korea
14:05~14:25	**Invited Lecture** **Title:** Novel metal /oxide nano-composites for semiconductor-mediated photocatalytic splitting of water to produce H2 Narendra Gupta, Catalysis Division, National Chemical Laboratory, India
14:25~14:45	**Invited Lecture** **Title:** Nanomaterials for a Clean and Secure Energy Future Meilin Liu, Georgia Institute of Technology, USA
14:45~15:05	**Invited Lecture** **Title:** Functional Materials, Nano-Electronics/Spintronics/Photonics, and Ultrafast DNA Sequencing Kwang S Kim, Pohang University of Science and Technology, South Korea
15:05~15:25	**Invited Lecture** **Title:** METAL OXIDE NANO-MATERIALS FOR CHEMICAL GAS SENSORS Pradosh Prakash Sahay, Motilal Nehru National Institute of Technology, India
15:25~15:40	**Coffee Break**
15:40~16:00	**Invited Lecture** **Title:** The Size Effect from the Nanoscale to the Hall-Petch Effect David Dunstan, University of London, London E1 4NS, UK
16:00~16:20	**Invited Lecture** **Title:** Sustainable Nanostructure Carbon Materials of for Supercapacitor Zhengrong Gu, South Dakota State University, USA
16:20~16:40	**Invited Lecture** **Title:** Nanoheterostructures in narrow-gap InSb/InAs(Sb,P) system: growth, characterisation and application Konstantin Moiseev, Ioffe Institute, Politekhnicheskaya 26, St. Petersburg, 194021, Russia
16:40~17:00	**Invited Lecture** **Title:** Soft Solution processing of ZnO nanoarrays by combining Electrophoretic Deposition and Hydrothermal Growth Marco Peiteado, Instituto de Cerámica y Vidrio - CSIC, Spain
17:00~17:20	**Invited Lecture** **Title:** Unique aspects of Vanadium oxide based nano materials in terms of structural morphologies and diverse applications G.T. Chandrappa, Bangalore University, India