Grafting of Conductive Polymers onto the Functionalized Carbon Nanotubes

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Summary: Multi-walled carbon nanotubes (MWNTs) was functionalized and used as conducting bridge in the polyaniline (PANi) matrix. Since MWNTs are exceptional materials having many advantages as follows. The one is that they assumed to have good crystalline structure and thus, they are expected to show outstanding properties. The other is that they are considered as *pseudo*-one dimendional materials with high aspect ratio (length/diameter) and thus, they are expected to display low percolation treshold. To take advantages of those features, however, they have to be homogeneous dispersion into supporting matrices without damages such as side wall opening, breaking and turning amorphous carbons. Although many researchers have been studied on carbon nanotubes (CNTs) for two decades since their discovery, a remaining challenge is still homogeneous dispersion of CNTs into individual CNT. The most of investigators have explored the easiest ways to disperse CNTs by chemical oxidization in strong acids or physical breaking by sonication. Both approaches, however, destroy carbon frameworks resulting in loosing the outstanding properties of CNTs. The challenge in this proposal was covalent attachment of reactive functional groups onto the surface of MWNT with minimal damages. PNAi was able to graft onto the surface of functionalized MWNT. The resultant PANi grafted MWNT displayed significantly improved electrical properties. The results of proposed project has been presented in academic meetings and published in journals. They are listed below. The rest of portions are still pursuing and the results will be published to academic journals.

Journals

1. Jeon, I.-Y.; Tan, L.-S.; Baek, J.-B. "Grafting of Polyaniline onto the Surface of 4-Aminobenzoyl-Functionalized Multi-Walled Carbon Nanotube and Its Electrochemical Properties" *Journal of Polymer Science, Part A: Polymer Chemistry* **2010,** 48(14), 3103-3112.
2. Kang, J.Y.; Eo, S.-M.; Oh, S.-J.; Tan, L.-S.; Baek, J.-B. "Electrically conducting, thermally stable, toughest poly(2,5-benzimidazole)/carbon nanotube composite film" *Journal of Polymer Science, Part A: Polymer Chemistry* **2010**, 48, 1067.
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4. Baek, J.-B.; Lyons, C. B.; Tan, L.-S. "Macromolecular Dumbbells: Synthesis and Photophysical Properties of Hyperbranched Poly(ether-ketone)-b-Polybenzobisthiazole-b-Hyperbranched Poly(ether-ketone) ABA Triblock Copolymers" *Journal of Materials Chemistry* **2009**, 19, 4172-4182.
5. Jeon, I.-Y.; Tan, L.-S.; Baek, J.-B. "Self-Controlled Synthesis of Hyperbranched Poly(ether-ketone)s from

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14. ABSTRACT

Multi-walled carbon nanotubes (MWNTs) were functionalized and used as conducting bridge in the polyaniline (PANi) matrix. Since MWNTs are exceptional materials having many advantages as follows. The one is that they assumed to have good crystalline structure and thus, they are expected to show outstanding properties. The other is that they are considered as pseudo-one dimendional materials with high aspect ratio (length/diameter) and thus, they are expected to display low percolation treshold. To take advantages of those features, however, they have to be homogeneous dispersion into supporting matrices without damages such as side wall opening, breaking and turning amorphous carbons. Although many researchers have been studied on carbon nanotubes (CNTs) for two decades since their discovery, a remaining challenge is still homogeneous dispersion of CNTs into individual CNT. The most of investigators have explored the easiest ways to disperse CNTs by chemical oxidization in strong acids or physical breaking by sonication. Both approaches, however, destroy carbon frameworks resulting in loosing the outstanding properties of CNTs. The challenge in this proposal was covalent attachment of reactive functional groups onto the surface of MWNT with minimal damages. PNAi was able to graft onto the surface of functionalized MWNT. The resultant PANi grafted MWNT displayed significantly improved electrical properties. The results of proposed project has been presented in academic meetings and published in journals. They are listed below. The rest of portions are still pursuing and the results will be published to academic journals.

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1. In-Yup Jeon, Jong-Beom Baek "Grafting of Polyaniline onto the Surface of Amino-Functionalized Multi-Walled Carbon Nanotube via interfacial Polymerization." MRS. 2009 fall meeting, Prepr. Boston, MA, November 30-December 4.
2. Kyung-Soo Kim, In-Yup Jeon, Jong-Beom Baek "Reinforcing Efficiency of Epoxy Resin by 4-(Aminophenoxy)Benzoyl-functionalized Carbon Nanotubes and Carbon Nanofibers." MRS. 2009 fall meeting, Prepr. Boston, MA, November 30-December 4.
3. Hyun-Jung Choi, In-Yup Jeon, Jong-Beom Baek "Stable anchoring of gold nanoparticle onto thiol-functionalized multi-walled carbon nanotube and its electrochemical properties " MRS. 2009 fall meeting, Prepr. Boston, MA, November 30-December 4.
4. Jong-Kwan Lim, Jong-Beom Baek "Purification and Functionalization of Diamond Nanopowders." MRS. 2009 fall meeting, Prepr. Boston, MA, November 30-December 4.
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