THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

INSTITUTE OF TEXTILES & CLOTHING 紡織及製衣學系

# Creation of high-performance nanostructures by using carbon nanotubes (CNTs) as the constructive elements

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**Abatract:**

Carbon nanotubes (CNTs) have been acting as the key materials epitomizing the field of nanoscience and nanotechnology for more than decades. Many potential applications implied by their remarkable electrical, mechanical properties and the unique morphologies have been proposed for CNTs; their self-aggregation characteristics, i.e., they self-aggregate to form aggregates, on the other hand, have been the critical barriers for their chemical and/or physical manipulation, and thus their use in practical applications. We have long been working on developing methods for dispersing the aggregated CNTs into individual tubes and have finally achieved the goal of production of aqueous and non-aqueous dispersions containing CNTs at the mono-dispersed (tubular) level for dispersions without need for any chemical modification of the tubes. Reversed phase micelles, such as bile derivatives, were used as the dispersant and the dispersion of the aggregated CNTs into individual tubes was achieved via three key approaches: i) the wetting approach, the solid/liquid (CNT/solvent) interfaces were activated by replacing air and/or moisture from the surfaces of the aggregated CNTs by using the reversed phase micelles as the wetting reagent via a wetting approach, reversed phase zwitterionic micelles gave the best wetting efficiency, followed by the nonionic micelles, and then the cationic and/or anionic micelles; ii) the dispersing approach, the well wetted aggregated CNTs have been treated by using a shearing and/or grinding system, the aggregated CNTs after being thoroughly wetted could be easily dispersed into individual tubes with very little or no mechanical damages under the mechanical shearing/grinding treatment, a continuously operating beans-milling system gave the highest production capability, followed by the jet-milling, and then the ultra-sonication; iii) the stabilizing approach, the mono-dispersed CNTs having high stabilities have been obtained by adding a small amount of stabilizers into the mono-dispersed CNT dispersions, poly-ions, such as carboxymethyl cellulose (CMC), large molecular weight DNA are the best stabilizers, followed by the highly hydrophilic nonionic polymers, such as polyvinyl alcohol (PVA) and then polyvinylpyrrolidone (PVP). The mono-dispersed unmodified CNTs have shown a high tendency to form continuously interconnected CNT-networks through a self-assembling approach. CNT based “smart yarns”, transparent and electrically conductive films, CNT/cellulose papers, and CNT-reinforced alloys, as the certain examples of the practical applications, will be also mentioned. The mono-dispersed unmodified CNTs have constructed continuously interconnected networks, providing the resultant materials electrically conductive and physically strong. Key things regarding the scientific fundamentals and the innovative applications of the mono-dispersed unmodified CNTs will be mentioned in this lecture.

***ALL ARE WELCOME!***

**Professor FUGETSU Bunshi**

Professor FUGETSU Bunshi received his Ph.D. degree from Nagoya University, Japan. After many years of skill trainings under Prof. Morinobu Endo's supervision (Shinshu University, Japan) and Prof. Mildred Dresselhaus' supervision (Massachusetts Institute of Technology, U.S.A.), he worked independently as a faculty professor in Graduate School of Environmental Earth Sciences at Hokkaido University (Japan) for developing applied nanomaterials and nanotechnologies. He is currently Project Professor in Applied Nanoscience & Nanotechnology Laboratory, Policy Alternative Research Institute, The University of Tokyo. His research areas include nanomaterials and nanotechnologies for i) environmental remediation, ii) energy storage and iii) wearable & washable vital sensors. He together with his colleagues received the 4th (2012) National Technology Innovation Award (Monotsukuritaisyou) from the Ministry of Economy, Trade and Industry, for the outstanding achievement of developing smart yarns by dye-printing yarns with mono-dispersed carbon nanotubes.