Functionalization of Carbon Nanotubes and Preparations of Carbon Nanotube Hybrid Composites

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Owing to their unique thermal, electronic, and mechanical properties, carbon nanotubes (CNTs) have attracted a great deal of attention [1]. However, CNTs are assembled and heavily entangle with each other, which makes them difficult to handle for further applications. Considerable attempts have been made, such as derivatization of tube ends and sides to improve the properties of CNTs. On the other hand, CNTs can be considered ideal templates for formation of one-dimensional nanoparticle assemblies for making heterogeneous catalysts [2-4] and preparation of CNTs hybrid composite is another fascinating way.

Firstly, efficient coupling of single-walled carbon nanotubes (SWNTs) with Br\(^{-}\), PF\(_6\), BF\(_4\), and POMs is achieved in a simple anion-exchange reaction through an ionic liquid backbone [5]. The resulting compounds retain the original properties of each component and display unusual tunable wettabiltiy and charge-transfer activity.

Secondly, electrochemical functionalization of single-walled carbon nanotubes was one of selective, clean, and nondestructive chemical methods. But in previous studies it met difficulties in homogeneous electrografting of SWNTs in large quantities because the reaction was often localized on a very thin film (ca. 2 \( \mu m \)). In our studies, large quantities of SWNTs were considerably untangled in room-temperature ionic liquid (RTIL) so as to greatly increase the effective area of the electrode [6].

Third, silica materials have poor mechanical attributes, which limit their applications. Because of the extreme flexibility of SWNTs and their large interfacial area, they were extended into silica monoliths and thin films as reinforcing components via covalent functionalization for the first time [7].

At the same time, multi-walled carbon nanotubes/gold composites were synthesized via electrochemistry process [8] and electrostatic interactions [9]. These composites exhibit good electrocatalytic activities towards ascorbic acid [8] and oxygen reduction [9], respectively. In addition, platinum-supported carbon nanotubes multilayer film based on electrostatic interaction by layer-by-layer self-assembly technique [10]. The film showed good electrocatalytic activity towards methanol oxidation.

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