Carbon Nanotube Applications as Smart Grid - Toward the Safe and Sustainable Innovations

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Since the advent of the green technology era, carbon nanotubes have attracted lots of attention because of their excellent physical and chemical properties that make them promising as a key element in fabricating nano-devices, transparent conductive film, light but tough composites as well as high-performance energy storage devices. For example, competition among countries is heating up for the development of light and powerful electric vehicles around the world. The key issues to move electric vehicles efficiently are how to fabricate light but strong vehicles and how to prepare large energy storage device with high-rate capability. Up to now, the contribution of carbon-based materials to our daily life should not be underestimated, because the incorporation of optimally engineered carbon nanotubes with large surface area and high electrical conductivity allow them to improve capacity and to prolong cycle life time [1, 2].

At present, carbon nanotubes are currently available in a large quantity because of the development of the cost-effective synthetic techniques for producing carbon nanotubes in an industrial scale. Therefore, a synergistic effect of an industrially produced carbon nanotubes and the newly created end-uses will cut down their price by at least 10 percent of the current value in the near future. We should pay much attention to the safety issue of carbon nanotubes for their numerous applications. It is reported that carbon nanotubes induced mesothelioma by intraperitoneal application [3] and by introduction into the abdominal cavity of mice [4]. The evaluations considering the exposure route were reported elsewhere [5, 6].

In this account, I, first, describe the current usage of carbon nanotubes in energy storage devices as one of the important component of lithium ion secondary batteries, supercapacitor and fuel cell with a special emphasis on their morphology and texture. The effectiveness of the addition of carbon nanotubes to both the cathode and anode electrode on the performance of lithium ion secondary batteries will be discussed in detail. Second, the application of carbon nanotubes as the electrode for supercapacitor will be described in terms of their pore size and distributions. Then, the optimally treated surface of nanotubes is effective for anchoring small sized Pt particles homogeneously. It is envisaged that the usage of nanotubes in the commercialized energy storage devices will increase abruptly when considering our energy-oriented society. Second, the industrial usages of carbon nanotubes as multi-functional filler in polymeric and metal composites will be described. Finally, we have to clarify the potential toxic of carbon nanotubes through the systemic study of various carbon nanotubes because the controlled safety of carbon nanotubes is critical for successful green innovation. In present, we have proceeded beyond the first mountain of science, the second mountain of technology and the third mountain of economy of carbon nanotubes. Now we are striving to climb the mountain of society by getting the societal implications with the complete understanding of toxicity.

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