Ultra Strong and Ultra Conductive Carbon Nanotube Reinforced Metal Composites

Schematic Of An Exemplary Electrochemical Co-deposition Apparatus For Forming Nanocomposites According To The Invention

Methods for the fabrication of carbon nanotube reinforced metal nanocomposite materials

There is an unrelenting passion for the development of improved high performance new materials which has spawned the production of today’s composite materials. These materials are particularly attractive because of their exceptional strength, stiffness-to-density ratios and superior physical properties. Composite materials are formed when various distinct materials are engineered together to create a new material. The idea is to capitalize on the advantages of each component material, while minimizing their weaknesses. These improved composite materials can be engineered with unique physical properties to suit very distinct applications. Carbon nanotube (CNTs) composites have recently received a lot of attention in this area. CNTs exhibit extraordinary strength and unique electrical properties, and are efficient conductors of heat. Previous efforts in forming carbon nanotube composites generally disclose blending nanotubes into a polymer matrix, much like a fiberglass composite. However, the polymer matrices achieve only about 20% to 50% reinforcement, resulting in a very weak interface bonding between the nanotubes and the polymer matrix. Furthermore, this method for fabrication of carbon nanotubes composites is not efficient as the strength of polymer based nanocomposites is very low, owing to the weak interface bonding. Therefore a new method for the fabrication of carbon nanotube composites is needed.

Technical Details

The present invention introduces a highly efficient method for the fabrication of ultra-strong carbon nanotube composites by using reinforced metal materials. A low temperature in situ metallic nanotube reinforced composite is fabricated by electroforming, a process of controlling the metal deposit from an anode metal, through electrolyte solution, onto an electroconductive surface. This novel, low cost method allows the nanotubes to be uniformly distributed over the metallic matrix, resulting in high interfacial bonding strength. The carbon nanotube reinforced metal nanocomposites provide thermal and electrical conductivity which are both significantly higher than the pure metal continuous phase material. Moreover, single wall carbon nanotubes (SWNTs) are used for the reinforcement of the metallic nanocomposite, increasing its mechanical strength 10 to 20 times more than the original material. The ultra strong tensile strength and excellent thermal and electrical conductivity of the metallic nanocomposites are novel properties that make these new and improved materials strong candidates to a broad range of applications.

Benefits

• Significantly lower costs
• Low temperature and atomic level growing
• Carbon nanotube composites can be grown at predefined locations on a material

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• Stronger composite
• Mechanical strength of metallic nanocomposite can be increased 10 to 20 times stronger than the original metallic material
• Thermal conductivity of the metallic nanocomposite will be 4 to 10 times higher than original metallic materials

Applications
• Nanotechnology
• Electronics
• Biological sensors and actuators
• Optics

• Materials science
• Architectural fields
• Robust micro-electro-mechanical systems (MEMS)

Additional Technology Numbers: 31682

Technology #30562

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