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(54) Titre : ELECTRO-DEPOT INSTANTANE DE NANOSTRUCTURES METALLIQUES SUR DES NANOTUBES DE CARBONE

(54) Title: INSTANTANEOUS ELECTRODEPOSITION OF METAL NANOSTRUCTURES ON CARBON NANOTUBES

(57) Abrégé/Abstract:
A method comprising: dispersing carbon nanotubes in a solvent; and depositing the carbon nanotubes on a porous, conductive substrate; wherein the porous, conductive substrate is capable of functioning as a filter and a working electrode. The method of claim 1 further comprising: engaging the porous, conductive substrate with deposited carbon nanotubes in an electrochemical cell; and depositing at least one metallic structure on the surface of the carbon nanotubes from an electrolyte solution to form metallized carbon nanotubes. A composite comprising: metallized carbon nanotubes generated by the method of claim 2; wherein the at least one metallic structure comprises a conductive metal atom selected from the group consisting of platinum, gold, nickel, copper, iron, chromium, zinc, and combinations thereof; and a matrix material selected from the group consisting of epoxies, thermosets, thermoplastics, elastomers, metals, metal matrix composites, ceramics and combinations thereof.

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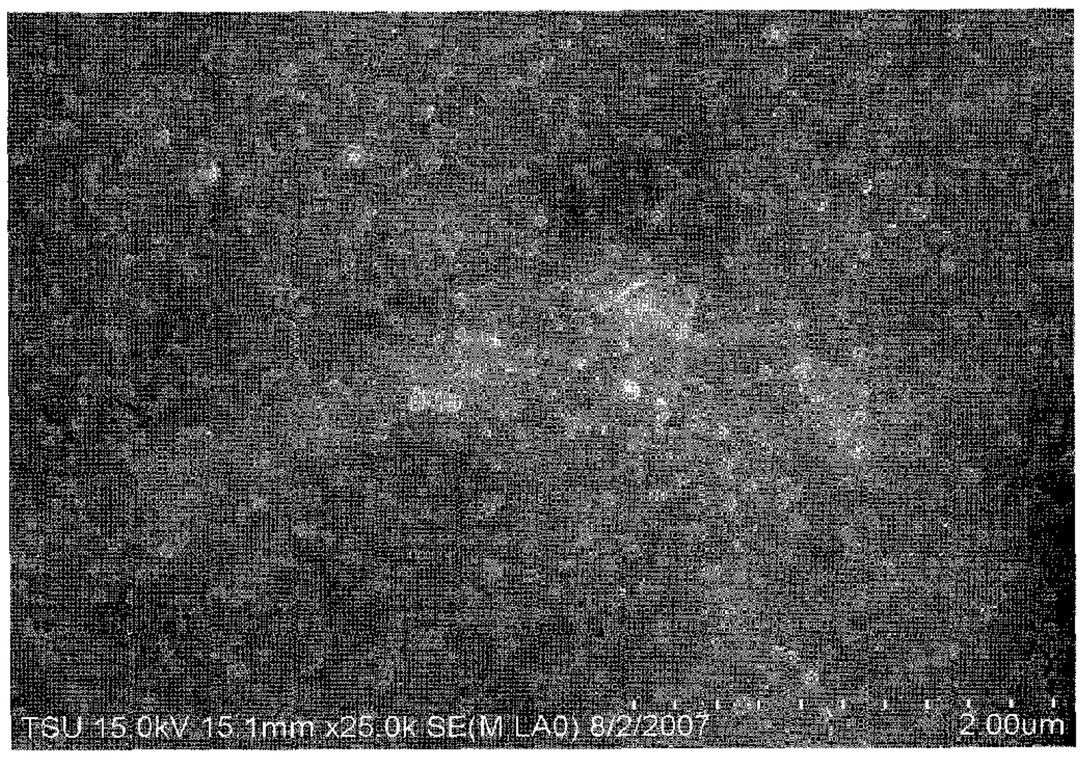

Figure 13

(57) Abstract: A method comprising: dispersing carbon nanotubes in a solvent; and depositing the carbon nanotubes on a porous, conductive substrate; wherein the porous, conductive substrate is capable of functioning as a filter and a working electrode. The method of claim 1 further comprising: engaging the porous, conductive substrate with deposited carbon nanotubes in an electrochemical cell; and depositing at least one metallic structure on the surface of the carbon nanotubes from an electrolyte solution to form metallized carbon nanotubes. A composite comprising: metallized carbon nanotubes generated by the method of claim 2; wherein the at least one metallic structure comprises a conductive metal atom selected from the group consisting of platinum, gold, nickel, copper, iron, chromium, zinc, and combinations thereof; and a matrix material selected from the group consisting of epoxies, thermosets, thermoplastics, elastomers, metals, metal matrix composites, ceramics and combinations thereof.

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CLAIMS:

1. A method of metallizing carbon nanotubes comprising:

dispersing carbon nanotubes in a solvent;

depositing the carbon nanotubes on a first portion of a porous, conductive substrate;

wherein the porous, conductive substrate is a silver membrane filter and is capable of functioning as a working electrode;

engaging a second portion of the porous, conductive substrate in an electrochemical cell; and

electrodepositing at least one metallic nanostructure on the surface of the carbon nanotubes from metal ions in an electrolyte solution to form metallized carbon nanotubes,

wherein the electrodepositing comprises controlling the morphology of the at least one metallic nanostructure, and

wherein the morphology is selected from the group consisting of discrete particles, aggregations of particles, continuous coatings, discontinuous coatings and combinations thereof.

2. The method of claim 1, wherein the step of depositing the carbon nanotubes is accomplished by a method selected from the group consisting of pressure filtration, vacuum filtration, spraying, film coating, and combinations thereof.

3. The method of claim 1, wherein the carbon nanotubes are selected from the group consisting of single-wall carbon nanotubes, double-wall carbon nanotubes, multi-wall carbon nanotubes, nanofibers, and combinations thereof.

4. The method of claim 3, wherein the carbon nanotubes comprise single-wall carbon nanotubes.

5. The method of claim 3, wherein the carbon nanotubes comprise double-wall carbon nanotubes.

6. The method of claim 3, wherein the carbon nanotubes comprise multi-wall carbon nanotubes.

7. The method of claim 1, wherein the carbon nanotubes are further functionalized.

8. The method of claim 1, wherein the porous, conductive substrate is a membrane filter comprising a conducting material selected from the group consisting of platinum, gold, copper, and combinations thereof.

9. The method of claim 1, wherein the porous, conductive substrate comprises silver.

10. The method of claim 1, wherein the step of electrodepositing metallic nanostructures comprises an electrochemical technique selected from the group consisting of constant potential, linear sweep voltammetry, cyclic voltammetry, pulse voltammetry, and combinations thereof.

11. The method of claim 1, wherein the at least one electrodeposited metallic nanostructure has a morphology selected from the group consisting of discrete particles, aggregations of particles, continuous coatings, discontinuous coatings and combinations thereof.

12. The method of claim 1, wherein the step of electrodepositing the at least one metallic nanostructure is controlled by varying at least one condition selected from the group consisting of electrical potential, electrical current, temperature, pH, agitation rate, electrolyte compositions, deposition time, pulse settings, and combinations thereof.

13. The method of claim 1, wherein the step of electrodepositing the at least one metallic nanostructure is controlled by the physico-chemical properties of the carbon nanotubes.

14. The method of claim 1, further comprising non-disruptively separating the metallized carbon nanotubes from the porous, conductive substrate by a technique selected from the group consisting of reverse flow of solvent through the porous, conductive substrate, sonication in a solvent, vacuum desorption, hydrodynamic desorption, adhesion to an alternate substrate, and combinations thereof.

15. A metallized carbon nanotube made by any one of the methods of claims 1 or 14.

16. A composite comprising: metallized carbon nanotubes generated by the method of claims 1 or 14; wherein the at least one metallic nanostructure comprises a conductive metal atom selected from the group consisting of platinum, gold, silver, nickel, copper, cobalt, iron, chromium, zinc, lead, cadmium, mercury, and combinations thereof; and a matrix material selected from the group consisting of epoxies, thermosets, thermoplastics, elastomers, metals, metal matrix composites, ceramics and combinations thereof, wherein the metallized carbon nanotubes are incorporated in the matrix material.