SUMMARY

[00010] The present invention satisfies these and other needs by providing, in one aspect, transparent conducting films, which include nanoribbons of uniform length and greater than 90% purity and methods of synthesis thereof.

[00010a] Disclosed herein is a transparent conducting film of claim 1, comprising graphene nanoribbons of uniform length of 30 µm, 50 µm, 100 µm, 150 µm or 200 µm and greater than about 99% purity.

[00011] In another aspect provided are devices, which include transparent conducting films comprised of graphene nanoribbons of uniform length and greater than 90% purity. The device may be a solar cell, a television, a display, a touch screen or a smart window.

BRIEF DESCRIPTION OF THE FIGURES

[00012] Fig.1 illustrates an exemplary flowchart for synthesis of carbon nanotubes, which includes the steps of depositing catalyst on a substrate; forming carbon nanotubes on a substrate; separating carbon nanotubes from the substrates; and collecting carbon nanotubes of high purity and structural uniformity

[00013] Fig.2 illustrates an exemplary flowchart for synthesis of carbon nanotubes, which includes the steps of forming carbon nanotubes on a substrate; separating carbon nanotubes from the substrates; and collecting carbon nanotubes of high purity and structural uniformity.

[00014] Fig.3 illustrates an exemplary flowchart for continuous synthesis of carbon nanotubes, which includes the steps of continuously depositing catalyst on a constantly moving substrate; forming CNTs on the moving substrate; separating CNTs from the moving substrate; and collecting carbon nanotubes of high purity and structural uniformity.

[00015] Fig.4 illustrates an exemplary flowchart for continuous synthesis of carbon nanotubes, which includes the steps of forming CNTs on the moving substrate containing metal substrate; separating CNTs from the moving substrate; and collecting carbon nanotubes of high purity and structural uniformity.

[00016] Fig.5 schematically illustrates a device for the continuous synthesis of carbon nanotubes, which includes various modules sequentially disposed such as a transport module for advancing the substrate through the modules; a catalyst

Claims

1. A transparent conducting film, comprising graphene nanoribbons of uniform length of 30 µm, 50 µm, 100 µm, 150 µm or 200 µm and greater than 99% purity.

2. The transparent conducting film of claim 1, wherein the graphene nanoribbons are of a thickness of less than 10 layers or less or 5 layers or less, 1 layer or less.

3. The transparent conducting film of claim 1, wherein the film has an optical transparency of greater than 80%, 85%, 90% or 95% in the visible spectrum.

4. The transparent conducting film of claim 1, wherein the film has sheet resistance of less than 1000 ohms per square, less than 100 ohms per square or less than 50 ohms per square.

5. The transparent conducting film of claim 1, wherein the film has surface roughness of less than 25 nm, less than 15 nm, less than 10 nm, less than 5 nm or less than 1 nm.

6. The transparent conducting film of claim 1, wherein the film is doped with nitric acid, iron chloride, gold chloride, ammonia gas or combinations thereof.

7. The transparent conducting film of claim 1, further comprising a nanowire.

8. The transparent conducting film of claim 7, where the nanowire is comprised of Au or Ag.

9. The transparent conducting film of claim 6, wherein the film encapsulates a nanowire.

10. The transparent conducting film of claim 1, further comprising single walled carbon nanotubes and/or double walled carbon nanotubes.

11. The transparent conducting film of claim 10, further comprising a nanowire.

12. A device comprising the transparent conducting film of claim 1.

13. The device of claim 12, wherein the device is a solar cell, a television, a display, a touch screen, a smart window or a smart phone.

14. A glass substrate coated with the transparent conducting film of claim 1.

15. The glass substrate of claim 14, wherein the transparent conducting film is flexible.

16. A plastic substrate coated with the transparent conducting film of claim 1.

17. The plastic substrate of claim 16, wherein the transparent conducting film is flexible.