dispersing media to become viscous until heated, and then when heated, the solvents volatilize rapidly, leaving only the CNTs behind. However, this method does not generate long term stability. The acid-amine adduct made by the CO_2 will degrade at room temperature, causing the viscosity to decrease with time. The adduct can be reformed by bubbling CO_2 back through the sample, but this property necessitates onsite manufacturing, and the product must be used immediately after manufacture.

Similar fugitive viscosity modifiers include the use of solid ammonium acid salts as a viscosity modifier for organic bases. Ammonium carbonate is a salt composed of water, carbon dioxide, and ammonia. When a molecule that is sufficiently basic reacts with the ammonium carbonate or ammonium carbamate salt, it will displace the ammonia. If the molecule is dibasic, then a hydrogen bonded carbonic acid polymer chain can form. Since the fluid is then composed of long molecular chains, its viscosity will be increased dramatically. The hydrogen bonded polymer will decompose at a low temperature. The use of a solid reagent (ammonium carbonate) is simpler than the use of gaseous CO_2 in the V2V™ process.

For transparent conductive applications, it is ideal that the carriers completely removable. Otherwise, residues may interfere with the transparency or conductivity of the traces. Many flexible substrates cannot tolerate high temperatures during post-processing, so it is important that the carrier can be easily removed at low temperatures.

SUMMARY

The present disclosure broadly overcomes the problems of the prior art by providing a dispersion in the form of a film on a substrate comprising carbon nanotubes mixed with a C_2-C_6 multifunctional alcohol. The dispersion is free of surfactants and comprises carbon nanotubes selected from the group consisting of pristine carbon nanotubes, carbon nanotubes which have been functionalized with one or more polyaromatic moieties, and combinations thereof. The said multifunctional alcohol is provided in said dispersion in an amount of from 90% to 99.999% by weight.

The disclosure also provides a method of preparing a carbon nanotube film, where the method comprises providing a dispersion comprising carbon nanotubes mixed with a C_2-C_6 multifunctional alcohol and forming said dispersion into a film on a substrate. The said dispersion is free of surfactants and comprises carbon nanotubes selected from the group consisting of pristine carbon nanotubes, carbon nanotubes which have been functionalized with

one or more polyaromatic moieties, and combinations thereof and multifunctional alcohol in an amount of from about 90% to 99.999% by weight.

In another aspect, the disclosure also refers to a dispersion comprising carbon nanotubes mixed with a C_2-C_6 multifunctional alcohol. A film formed from the dispersion has a sheet resistance of less than 7,000 Ω/sq at 85% T. The dispersion is free of surfactants. Carbon nanotubes in the dispersion is in a range from 0.01% to 5% by weight, based upon the total weight of the dispersion taken as 100% by weight. The multifunctional alcohol in the dispersion is in a range from 90% to 99.999% by weight, based upon the total weight of the dispersion taken as 100% by weight.

I Claim:

1. A dispersion in the form of a film on a substrate, said dispersion comprising carbon nanotubes mixed with a C_2-C_6 multifunctional alcohol, wherein:

said carbon nanotubes are selected from the group consisting of pristine carbon nanotubes, carbon nanotubes which have been functionalized with one or more polyaromatic moieties, and combinations thereof;

said dispersion is free of surfactants; and

said multifunctional alcohol is present in said dispersion in an amount of from 90% to 99.999% by weight, based upon the total weight of the dispersion taken as 100% by weight.

2. The dispersion of claim 1, wherein said multifunctional alcohol is selected from the group consisting of diols and triols.

3. The dispersion of claim 1, wherein said multifunctional alcohol is selected from the group consisting of 2-methyl- 1,3 -propanediol, 1,2-propanediol, 1 ,3-propanediol, glycerol, and ethylene glycol.

4. The dispersion of claim 1, having a carbon nanotube concentration of from 0.01% to 5% by weight, based upon the total weight of the dispersion taken as 100% by weight.

5. The dispersion of claim 1, further comprising a solvent other than a multifunctional alcohol in said dispersion.

6. The dispersion of claim 1, said dispersion being formable into a film having a sheet resistance of less than 7,000 Ω/sq at 85% T.

7. The dispersion of claim 1 wherein said carbon nanotubes are selected from the group consisting of single-walled, double-walled, and multi-walled carbon nanotubes.

8. The dispersion of claim 1, wherein said one or more polyaromatic moieties are selected from the group consisting of naphthalene, anthracene, phenanthracene, pyrene, tetracene, tetraphene, chrysene, triphenylene, pentacene, pentaphene, perylene,

benzo[a]pyrene, coronene, antanthrene, corannulene, ovalene, graphene, fullerene, cycloparaphenylene, polyparaphenylene, and cyclophene.

9. The dispersion of claim 1, wherein said substrate is selected from the group consisting of polyethylene terephthalate, polyimide, FR-4, breadboard, poly(methyl methacrylate), polyacrylate, epoxy, polyurethane, paper, polyester, polyethylene, silicon, SiGe, $Si0_2$, Si_3N_4, aluminum, tungsten, tungsten silicide, gallium arsenide, germanium, tantalum, tantalum nitride, coral, black diamond, sapphire, phosphorous or boron doped glass, ion implant layers, titanium nitride, hafnium oxide, silicon oxynitride, and mixtures of the foregoing.

10. A method of preparing a carbon nanotube film, said method comprising:

providing a dispersion comprising carbon nanotubes mixed with a C_2-C_6 multifunctional alcohol, wherein:

said dispersion is free of surfactants;

said C_2-C_6 multifunctional alcohol is present in said dispersion in an amount of from 90% to 99.999% by weight, based upon the total weight of the dispersion taken as 100% by weight; and

said carbon nanotubes are selected from the group consisting of pristine carbon nanotubes, carbon nanotubes which have been functionalized with one or more polyaromatic moieties, and combinations thereof; and

forming said dispersion into a film on a substrate.

11. The method of claim 10, wherein said substrate is selected from the group consisting of polyethylene terephthalate, polyimide, FR-4, breadboard, poly(methyl methacrylate), polyacrylate, epoxy, polyurethane, paper, polyester, and polyethylene, silicon, SiGe, $Si0_2$, Si_3N_4, aluminum, tungsten, tungsten silicide, gallium arsenide, germanium, tantalum, tantalum nitride, coral, black diamond, sapphire, phosphorous or boron doped glass, ion implant layers, titanium nitride, hafnium oxide, silicon oxynitride, and mixtures of the foregoing.

12. The method of claim 10, wherein said dispersion is formed by mixing carbon nanotubes with the multifunctional alcohol in a roll mill.

13. The method of claim 10, wherein said film is formed by screen printing said dispersion onto said substrate.

14. The method of claim 10, further comprising heating said film.

15. The method of claim 14, wherein said heating is carried out at a temperature of from 50 °C to 450 °C.

16. The method of claim 14, wherein said heating causes substantially all of said multifunctional alcohol to evaporate from said film.

17. The method of claim 14, said film having a sheet resistance of less than 7,000 Ω/sq at 85% T.

18. The method of claim 10, wherein said carbon nanotubes are selected from the group consisting of single-walled, double-walled, and multi-walled carbon nanotubes.

19. The method of claim 10, said dispersion further comprising a solvent other than a multifunctional alcohol in said dispersion.

20. A dispersion comprising carbon nanotubes mixed with a C_2-C_6 multifunctional alcohol, said dispersion:

being formable into a film having a sheet resistance of less than 7,000 Ω/sq at 85% T;

having a carbon nanotube concentration of from 0.01% to 5% by weight, based upon the total weight of the dispersion taken as 100% by weight;

having a multifunctional alcohol concentration of from 90% to 99.999% by weight, based upon the total weight of the dispersion taken as 100% by weight; and

being free of surfactants.

21. The dispersion of claim 20, wherein said multifunctional alcohol is selected from the group consisting of 2-methyl-1,3-propanediol, 1,2-propanediol, 1,3-propanediol, glycerol, and ethylene glycol.

22. The dispersion of claim 20, said carbon nanotubes being noncovalently bonded to compounds comprising respective polyaromatic moieties, wherein at least some of said

polyaromatic moieties being reacted with an acid and wherein said compound comprising a polyaromatic moiety is selected from the group consisting of substituted and unsubstituted compounds selected from the group consisting of naphthalene, anthracene, phenanthracene, pyrene, tetracene, tetraphene, chrysene, triphenylene, pentacene, pentaphene, perylene, benzo[a]pyrene, coronene, antanthrene, corannulene, ovalene, graphene, fullerene, cycloparaphenylene, polyparaphenylene, cyclophene, and compounds containing moieties of the foregoing.

23. The dispersion of claim 20, wherein said carbon nanotubes are selected from the group consisting of single-walled, double-walled, and multi-walled carbon nanotubes.

24. The dispersion of claim 20, wherein said dispersion is in the form of a film on a substrate selected from the group consisting of polyethylene terephthalate, polyimide, FR-4, breadboard, poly(methyl methacrylate), polyacrylate, epoxy, polyurethane, paper, polyester, polyethylene, silicon, SiGe, SiO_2, Si_3N_4, aluminum, tungsten, tungsten silicide, gallium arsenide, germanium, tantalum, tantalum nitride, coral, black diamond, sapphire, phosphorous or boron doped glass, ion implant layers, titanium nitride, hafnium oxide, silicon oxynitride, and mixtures of the foregoing.