FIG. 8A is a graph of wear testing data showing the total volume (mm^3) of discs composed of the compositions of Example 1 and Comparative Example A, the data obtained using an UMT-2 Tribometer from Center for Tribology (Campbell, CA) with a pin-on-disc configuration and the test parameters having a pin with hemispherica tip (R=2mm), counterface of steel (HRC = 50-50) and Ra ≈ 0.05 μm, a circular wear path a with a sliding distance of 2500 m, normal ~~face~~ force of 0.2 kg, sliding velocity of 0.05 m/s, and the linear wear measured with capacitance sensor (0.025 μm resolution) and volume loss calculated from linear wear/sample geometry;

FIG. 8B is a graph of wear testing data showing average specific wear rate (mm^3/N-m) of discs composed of the compositions of Example 1 and Comparative Example A, the data obtained using an UMT-2 Tribometer from Center for Tribology (Campbell, CA) with a pin-on-disc configuration and the test parameters having a pin with hemispherical tip (R=2mm), counterface of steel (HRC = 50-50) and Ra ≈ 0.05 μm, a circular wear path with a sliding distance of 2500 m, normal ~~face~~ force of 0.2 kg, sliding velocity of 0.05 m/s, and the linear wear measured with capacitance sensor (0.025 μm resolution) and volume loss calculated from linear wear/sample geometry. The average specific wear rate is calculated by the volume loss per normal force per sliding distance;

FIG. 9A is a graph of molecular contamination data showing outgassing (ppm) for materials composed of compositions of Example 1, Comparative Example A and Comparative Example C (PEEK with about 20 wt-% carbon fibers and an aspect ratio of about 20 or greater);

FIG. 9B is a graph of molecular contamination data showing total anions (ppb) for materials composed of compositions of Example 1, Comparative Example A and Comparative Example C;

FIG. 9C is a graph of molecular contamination data showing total cations (ppb) for materials composed of compositions of Example 1, Comparative Example A and Comparative Example C;

FIG. 9D is a graph of molecular contamination data showing total metals (ppb) for materials composed of compositions of Example 1, Comparative Example A and Comparative Example C, with the material composed of the Example 1 composition having higher metal concentrations due to carbon nanotubes having metal bound thereto under normal use conditions;

CLAIMS

1. A composition comprising:

a thermoplastic polymer melt, an amount of carbon nanotubes, and an amount of carbon fibers extrusion compounded together in the composition, the amount of carbon nanotubes and the amount of carbon fibers dispersed in the polymer melt.

~~2. The composition of claim 1, wherein the carbon fibers have an aspect ratio greater than 1 and less than about 5.~~

~~3.~~2. The composition of claim 1, wherein the polymer melt is a high temperature, high strength thermoplastic polymer.

~~4.~~3. The composition of claim 1, wherein the carbon nanotubes comprise single wall carbon nanotubes, multiple wall carbon nanotubes, or a combination thereof.

~~5.~~4. The composition of claim 1, wherein the polymer melt comprises PEI, Polyimide, Poly ether sulfone (PES), Poly phenyl sulfone (PPS), Per fluoro alkoxy (PFA), Fluorinated ethylene propylene (FEP), Ethylene tri fluoro ethylene (ETFE) Poly sulfone, Polystyrene, Poly ether Ketone (PEK), Poly ether ketone ketone (PEKK), polybutylene terephthalate (PBT), polyolefins (PO), polyethylene terephthalate (PET), styrene block co-polymers, styrene-butadiene rubber, nylon in the form of polyether block polyamide (PEBA), polyetheretherketone (PEEK), poly(vinylidenefluroide), poly(tetraflurorethylene) (PTFE), polyethylene, polypropylene, poly(vinylchloride) (PVC), ethyl vinyl acetate, a blend thereof, copolymers thereof, or a combination thereof.

~~6.~~5. The composition of claim 1, wherein the polymer melt comprises PEEK, PI, or PEI.

~~7.~~6. The composition of claim 1, wherein the amount of carbon nanotubes is at least about 0.5% and less than about 5% by weight.

~~8.~~7. The composition of claim 1, wherein the amount of carbon nanotubes is about 3% by weight or less.

~~9.~~8. The composition of claim ~~1~~7, wherein the amount of carbon fibers is between about 20% and about 50% by weight.

~~10~~9. The composition of claim 1, wherein the amount of carbon fibers is between about 30% and about 45% by weight.

~~11~~10. The composition of claim ~~10~~9, wherein the amount of carbon nanotubes is between about 1.0% and about 2.0% by weight.

~~12~~11. An article comprising a molded composition of claim ~~11~~10.

~~13~~12. The article of claim ~~12~~11, wherein the article is a wafer carrier suitable for transporting semi-conductor wafers ~~flame retardant~~.

~~14~~13. The article of claim ~~12~~11 that has an average surface resistivity of less than about 10^9 ohms/sq.

~~15~~14. The article of claim ~~12~~11 that has an average surface resistivity between about 10^6 and about 10^8 ohms/sq.

~~16~~15. A composition comprising:

a thermoplastic polymer;

a network of nanotubes dispersed in the thermoplastic polymer; and

a network of carbon fibers having an aspect ratio greater than 1 and less than about 5 dispersed in the thermoplastic polymer;

wherein an amount of the nanotubes in the composition is greater than about 0.0 wt-% and less than about 5.0 wt-% and an amount of the carbon fibers is greater than about 20 wt-%.

~~17~~16. The composition of claim ~~16~~15 wherein the nanotubes have an aspect ratio of 100 or more.

~~18~~17. The composition of claim ~~16~~15 where the nanotubes are not polymer wrapped nanotubes.

~~19~~18. The composition of claim ~~16~~15 having a surface resistivity less than 10^9 ohms/sq.

~~20~~19. The composition of claim ~~16~~15 wherein the amount of nanotubes is between 0.5 wt % and 5 wt %.

~~21~~20. The composition of claim ~~16~~15 wherein the composition does not comprise added carbon beyond the nanotubes and carbon fibers ~~powders~~.

~~22~~21. A fluid handling article comprising the composition of claim ~~16~~15.

~~23~~22. A carrier comprising the composition of claim ~~16~~15.

~~24~~23. A housing comprising the composition of claim ~~16~~15.

2524. The composition of claim 16 15 wherein the amount of carbon fibers is between about 20% and about 50% by weight.

2625. The composition of claim 1619, wherein the amount of carbon fibers is between about 30% and about 45% by weight.

2726. An molded article comprising the composition of claim 1615.

2827. The molded article of claim 27 26 wherein the article comprises a wafer carrier suitable for transporting semi-conductor wafers.

2928. The molded article of claim 27 26 wherein the article comprises a bipolar plate.

3029. The molded article of claim 27 26 wherein the article comprises an electrode.

3130. The composition of claim 1615, wherein the nanotubes comprise functional groups located on the ends of the nanotubes, along the side walls of the nanotubes, or both.

3231. The composition of claim 3130, wherein the functional groups comprise fluorine.

3332. The composition of claim 1615, wherein the nanotubes comprise single wall carbon nanotubes, multiple wall carbon nanotubes or a combination thereof.

3433. A method of forming a composite for the manufacturing of an article, the method comprising

providing a polymer melt within an extruder;

injecting feeding an amount of nanotubes within into the extruder having the polymer melt;

injecting feeding an amount of carbon fibers having an aspect ratio greater than 1 and less than about 5 within into the extruder having the polymer melt; and

applying shear to blend the nanotubes, the carbon fibers, and the polymer.,

wherein a thermoplastic polymer melt is formed having the amount of carbon nanotubes and the amount of carbon fibers dispersed in the polymer melt.

3534. The method of claim 3433 wherein the nanotubes comprise single wall carbon nanotubes, multiple wall carbon nanotubes, or a combination thereof.

3635. The method of claim 3433 wherein the amount of the carbon fibers is less than between about 20% and about 50% by weight.

3736. The method of claim 3433 wherein the amount of carbon fibers is between about 25% and about 45% by weight.

3837. The composition method of claim 3435 wherein the amount of nanotubes is between about 0.5% and about 5% by weight.

3938. The ~~composition~~ method of any one of claims ~~34~~ 33, 35 and 36, wherein the amount of nanotubes is between about 1% and about 3% by weight.

4039. The ~~method~~ composition of claim ~~34~~15 wherein the ~~composite~~ composition is fed from ~~the~~ an extruder to a shaping apparatus where the ~~composite~~ composition is formed into an article having a desired shape and size.

4140. The ~~method~~ composition of claim ~~40~~ 39 wherein the shaping apparatus is selected form the group consisting of rollers, injection molds, compression molds, and combinations thereof.

4241. The method of claim ~~34~~33 wherein the extruder comprises a twin-screw extruder.

4342. A composite composition ~~comprising~~ consisting essentially of a polymer, 1% to 3% by weight nanotubes, and 20% to 50% by weight carbon fibers having an aspect ratio greater than 1 and less than about 5 as described herein.

4443. An article formed from a composite composition consisting essentially of ~~comprising~~ a polymer, 1% to 3% by weight nanotubes, and 20% to 50% by weight carbon fibers having an aspect ratio greater than 1 and less than about 5 as described herein.

4544. ~~A~~ The method of claim 37, ~~forming a composite composition comprising a polymer, nanotubes, and carbon fibers having an aspect ratio greater than 1 and less than about 5 as described herein.~~ wherein the thermoplastic melt is fed from the extruder to a shaping apparatus where the thermoplastic melt is formed into an article having a desired shape and size.

4645. A method of manufacturing an article having a composite composition ~~comprising~~ consisting essentially of a polymer, 1% to 3% by weight nanotubes, and 20% to 50% by weight carbon fibers having an aspect ratio greater than 1 and less than about 5 as described herein.