CLAIMS

We claim:

1. An elastomeric article having one or more of a dissipative effect and a quantum tunneling composite effect in an end application subject to compressive stress, wherein the elastomeric article is formed from an elastomeric composition that comprises:

at least one curable matrix polymer comprising at least one curable polymer having at least one functional group for crosslinking, and

a three-dimensional, branched and crosslinked carbon nanostructure additive, wherein the carbon nanostructure additive is in the elastomeric article in an amount such that in use, the elastomeric article (i) is an insulator when not subjected to the compressive stress, and is conductive when subjected to the compressive stress, and/or (ii) has a conductivity level when subjected to the compressive stress that is different than a conductivity level when not subjected to the compressive stress so that the elastomeric article demonstrates one or more of a dissipative effect and a quantum tunneling composite effect, and

wherein the elastomeric article has a change in conductivity level under the compressive stress in use that indicates performance of the elastomeric article in real time.

2. The elastomeric article according to claim 1, wherein the elastomeric composition comprises 1 part by weight to 30 parts by weight of the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

3. The elastomeric article according to claim 2, wherein the elastomeric composition comprises 1 to 15 parts by weight of the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

4. The elastomeric article according to claim 1, wherein the elastomeric article exhibits a quantum tunneling effect, and wherein the elastomeric composition comprises at least 2 parts by weight of the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

5. The elastomeric article according to claim 4, wherein the elastomeric composition comprises at least 3 parts by weight of the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

6. The elastomeric article according to claim 5, wherein the elastomeric composition comprises at least 4 parts by weight of the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

7. The elastomeric article according to claim 6, wherein the elastomeric composition comprises 4 parts by weight to 20 parts by weight of the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

8. The elastomeric article according to claim 7, wherein the elastomeric composition comprises 4 to 15 parts by weight of the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

9. The elastomeric article according to claim 1, wherein the at least one matrix polymer is selected from the group consisting of polyarylene-based polymers, thermoplastic melt-processible fluoropolymers, polyvinyl chloride, polyvinylidene fluoride, polytetrafluoroethylene, chlorinated fluoropolymers, silicon-based polymers, and non-curable fluoropolymers and perfluoropolymers, polyolefins, polyethylene terephthalates, polysiloxanes, polyurethanes, polyaramid, polyamides, polyimides, polyetherimides, polyphenylene sulfides, polyphenylene sulfones, polyether sulfones, polyamideimides, polybenizmidizoles, polycarbonates, polyacrylonitrile-butadiene-styrenes, polybutadiene-styrenes, polyepoxides, and similar materials, as well as blends, copolymers, alloys, and other combinations thereof.

10. The elastomeric article according to claim 1, wherein the elastomeric composition further comprises at least one conductive filler different from the carbon nanostructure additive that is selected from the group consisting of powders, flakes and fiber fillers comprising one or more of carbon, metal-plated glass, metal-plated particles, wherein the particle comprises a metal or a polymer, nickel-coated graphite, graphene, graphite, carbon black, graphene derivatives, single-wall carbon nanotubes, multi-wall carbon nanotubes, gold, silver, nickel, copper, and combinations or mixtures thereof.

11. The elastomeric article according to claim 10, wherein the elastomeric composition comprises 0.25 parts by weight to 100 parts by weight of the one more conductive fillers different from the carbon nanostructure additive per 100 parts by weight of the at least one matrix polymer.

12. The elastomeric article according to claim 1, wherein the elastomeric article is an elastomeric quantum tunneling composite, and is selected from the group consisting of a seal, gasket, or other component in a sealing assembly.

13. The elastomeric article according to claim 1, wherein the at least one carbon nanostructured additive has a carbon content of greater than or equal to 97%.

14. The elastomeric article according to claim 1, wherein the elastomeric article is an elastomeric quantum tunneling composite and is a self-sensing article, and wherein when the elastomeric article is in electrical communication with a circuit and a voltage is applied, a change in conductivity of the elastomeric article is measured when the elastomeric article is in use and subject to compressive stress and the change in conductivity is used to determine and evaluate the performance of the elastomeric article in real time.

15. A method of making an article, comprising

providing an elastomeric composition comprising at least one matrix polymer comprising at least one curable polymer having at least one functional group for crosslinking and at least one carbon nanostructure additive that is three-dimensional, branched and crosslinked, wherein the at least one carbon nanostructure additive is present in an amount of at least 1 part by weight to 30 parts by weight per 100 parts by weight of the at least one matrix polymer; and

forming an elastomeric article from the elastomeric composition by curing and heat-forming the elastomeric composition, wherein when in an application the elastomeric article (i) is an insulator when not subjected to the compressive stress, and is conductive when subjected to the compressive stress, and/or (ii) has a conductivity level when subjected to the compressive stress that is different than a conductivity level when not subjected to the compressive stress so that the elastomeric article exhibits at least one of a dissipative effect or a quantum tunneling effect, and the elastomeric article has a change in conductivity level when under the compressive stress in use that indicates performance of the elastomeric article in real time.

16. The method according to claim 16, wherein the elastomeric article is a seal, a gasket, or other component in a sealing assembly.

17. The method according to claim 16, wherein the elastomeric composition comprises at least one crosslinking additive for reacting with the at least one functional group for crosslinking.

18. The method according to claim 16, wherein the curable polymer is selected from the group consisting of a curable fluoropolymer, a curable perfluoropolyether, and a curable perfluoropolymer, and blends and copolymers, thereof.

19. The method according to claim 16, wherein the elastomeric composition is an elastomeric quantum tunneling composite.

20. The method according to claim 16, wherein the at least one carbon nanostructured additive has a carbon content of greater than or equal to 97%.

21. The method according to claim 16, wherein the conductivity level of the elastomeric article when subjected to compressive stress is higher than the conductivity level of the elastomeric article when not subjected to compressive stress.

22. The method according to claim 16, wherein the elastomeric article is an elastomeric quantum tunneling composite and is a self-sensing article, and wherein when the elastomeric article is in electrical communication with a circuit and a voltage is applied, a change in conductivity of the elastomeric article is measured when the elastomeric article is in use and subject to compressive stress and the change in conductivity is used to determine and evaluate the performance of the elastomeric article in real time.