CLAIMS

~~1. A sensor comprising:~~

~~a. at least one elastomer layer;~~

~~b. at least one elastomer support matrix;~~

~~c. a piezoresistive element;~~

~~d. a spacer element; and~~

~~e. at least one pair of electrodes;~~

~~wherein the piezoresistive element and the spacer element are deposited on at least one elastomer layer, and wherein the spacer element allows contact to be reduced between at least some of the piezoresistive element when a force is exerted on the sensor.~~

1. A method of fabricating a flexible strain-sensitive pressure sensor, including the steps of:

a) depositing an elastomer material in liquid form on a patterned mold;

b) depositing a supporting mesh on the elastomer material;

c) curing the elastomer material to thereby form a textured elastomer layer having a textured surface and a support mesh layer;

d) depositing a graphite-based piezoresistive layer over the textured surface of the textured elastomer layer; and

e) overlaying a substrate layer supporting one or more electrodes therein.

~~2. The sensor of claim 1, wherein the piezoresistive element comprises graphene nanoparticles, carbon black, fullerene, carbon nanoparticles,~~

~~graphene oxide particles, functionalized carbon-based nanomaterials, graphite particles or a combination thereof.~~

2. A method according to claim 1, further including the step of attaching one or more structural supports on the textured surface.

~~3. The sensor of claim 1, wherein the elastomer layer comprises polydimethylsiloxane, polyurethane, polyethylene, poly (ethylene vinyl acetate), polyvinyl chloride, polyborodimethylsiloxane, polystyrene, acrylonitrile butadiene styrene, styrene butadiene styrene, ethylene propylene rubber, neoprene, cork, natural rubber, silicone, thermoplastic elastomeric gel, any other elastomeric material, or a combination thereof.~~

3. A method according to claim 2, further including the step of also depositing the graphite-based piezoresistive layer on the structural support(s).

~~4. The sensor of claim 1, wherein the elastomer layer may be substituted wholly or partially and comprises synthetic or natural latex, agar, a combination of water and starch, any other suitable elastic material, or a combination thereof.~~

4. A method according to any one of the preceding claims, wherein the patterned mold includes at least one of a coated abrasive sheet, etched silicon, glass or other textured material that is non-reactive to the elastomer.

~~5. The sensor of claim 1, wherein the sensor is used to measure an extent of deformation.~~

5. A method according to any one of the preceding claims, wherein the piezoresistive layer includes graphene nanoparticles, carbon black, fullerene, carbon nanoparticles, graphene oxide particles, functionalized carbon-based nanomaterials, graphite particles or a combination thereof.

~~6. The sensor of claim 1, wherein the sensor is a pressure sensor, stretch sensor, or a combination thereof.~~

6. A method according to any one of the preceding claims, wherein the elastomer layer includes polydimethylsiloxane, polyurethane, polyethylene, poly (ethylene-vinyl acetate), polyvinyl chloride, polyborodimethylsiloxane, polystyrene, acrylonitrile-butadiene-styrene, styrene-butadiene-styrene, ethylene-propylene rubber, neoprene, cork, natural rubber, silicone, thermoplastic elastomeric gel, or a combination thereof.

~~7. The sensor of claim 1, further comprising an air gap between the piezoresistive element and a substrate comprising electrodes.~~

7. A method of fabricating a flexible strain-sensitive pressure sensor, including the steps of:

f) depositing an elastomer material in liquid form on a substrate;

g) depositing a granular substance on the elastomer material;

h) curing the elastomer material and removing the granular substance to thereby form a textured elastomer layer having a textured surface;

i) depositing a graphite-based piezoresistive layer over the textured surface of the textured elastomer layer; and

j) overlaying a substrate supporting one or more electrodes therein.

~~8. The sensor of claim 1, wherein the average size of the spacer element is larger than that of the piezoresistive element.~~

8. A method according to claim 7, further including the step of applying one or more adhering, coupling or fastening means on the textured surface prior to deposition of the piezoresistive layer.

~~9. The sensor of claim 1, wherein the spacer element is immobilized on a layer comprising the piezoresistive element.~~

9. A method according to claim 7 or 8, further comprising attaching a conductive bridge layer on the electrode(s) supported by the substrate layer.

~~10. The sensor of claim 1, wherein the spacer element comprises a plurality of stationary, nonconductive elements located at certain intervals within the sensor.~~

10. A method according to any one of claims 7 to 9, wherein the piezoresistive layer includes graphene nanoparticles, carbon black, fullerene, carbon nanoparticles, graphene oxide particles, functionalized carbon-based nanomaterials, graphite particles or a combination thereof.

~~11. The sensor of claim 1, wherein the at least one elastomer layer is impregnated within the at least one elastomer support matrix.~~

11. A method according to any one of claims 7 to 10, wherein the elastomer layer includes polydimethylsiloxane, polyurethane, polyethylene, poly

(ethylene-vinyl acetate), polyvinyl chloride, polyborodimethylsiloxane, polystyrene, acrylonitrile-butadiene-styrene, styrene-butadiene-styrene, ethylene-propylene rubber, neoprene, cork, natural rubber, silicone, thermoplastic elastomeric gel, or a combination thereof.

~~12. The sensor of claim 1, wherein the at least one elastomer layer is an elastomeric adhesive.~~

12. A method of fabricating a flexible strain-sensitive pressure sensor, including the steps of:

a) depositing an adhesive type textured elastomer layer having a textured surface on a substrate;

b) depositing a graphite-based piezoresistive layer over the textured surface of the adhesive type elastomer layer; and

c) attaching the adhesive type textured elastomer layer to a substrate supporting one or more electrodes therein.

~~13. The sensor of claim 1, wherein the at least one elastomer support matrix comprises a flexible, stretchable material and a flexible, substantially non-stretchable material.~~

13. A method according to claim 12, wherein the textured surface of the adhesive type textured elastomer layer is formed using a patterned mold.

~~14. The sensor of claim 1, wherein the at least one elastomer layer comprises a textured surface.~~

14. A method according to claim 12, wherein the textured surface of the adhesive type textured elastomer layer is formed using a granular substance applied to and subsequently removed from the elastomer layer.

~~15. The sensor of claim 1, wherein the textured surface is prepared by molding, etching, or using a granular material.~~

15. A flexible strain-sensitive pressure sensor fabricated using a method according to any one of the preceding claims.

~~16. The sensor of claim 1, further comprising a second elastomer layer coated with a piezoresistive layer.~~

16. A flexible strain-sensitive pressure sensor according to claim 15, including a pair of opposing composite layers, each composite layer including a substate layer supporting a said textured elastomer layer coated with the piezoresistive layer, the composite layers being positioned with the piezoresistive layers facing each other, and with one or more electrodes provided between the opposing piezoresistive layers.

~~17. The sensor of claim 1, wherein the sensor is one of a plurality of sensors in a sensor assembly.~~

17. A flexible strain-sensitive pressure sensor according to claim 15, including a pair of opposing composite layers, one said composite layer including a

substate layer supporting a said textured elastomer layer coated with the piezoresistive layer, the other said composite layer included a substrate layer supporting an elastomer layer having a relatively planar surface coated with the piezoresistive layer, the composite layers positioned with the piezoresistive layers facing each other, and with one or more electrodes provided between the opposing piezoresistive layers.

~~18. The sensor of claim 1, wherein the at least one elastomer layer has a tubular shape.~~

18. A method of fabricating a flexible strain-sensitive stretch sensor, including the steps of:

a) preparing a first composite mesh layer by attaching a non-stretchable, flexible mesh material to opposing ends of a stretchable mesh material;

b) depositing elastomer material over the first composite mesh layer to form an elastomer layer thereon;

c) preparing a second composite mesh layer by attaching a non-stretchable, flexible mesh material to opposing ends of a stretchable mesh material;

d) depositing elastomer material over the second composite mesh layer to form an elastomer layer thereon;

e) depositing graphite conductive particles and spacer elements over the first elastomer layer;

f) securing electrodes at opposite ends of the first elastomer layer; and

g) securing the second composite elastomer-mesh layer over the first composite mesh layer to thereby retain in place the graphite conductive particles and spacer elements therebetween.

~~19. A strain sensor comprising:~~

~~a. at least one elastomer layer comprising at least one textured surface;~~

~~b. at least one elastomer support matrix;~~

~~c. a piezoresistive element in the form of graphite particles;~~

~~d. a plurality of spacer elements; and~~

~~e. at least one pair of electrodes,~~

~~wherein the graphite particles are deposited on the at least one textured surface,~~

~~wherein the plurality of spacer elements allows contact to be reduced between at least some of the piezoresistive element, and~~

~~wherein the plurality of spacer elements is mixed with the piezoresistive element or fixed at certain locations in the sensor.~~

19. A method according to claim 18, wherein the graphite conductive particles includes graphene nanoparticles, carbon black, fullerene, carbon nanoparticles, graphene oxide particles, functionalized carbon-based nanomaterials, graphite particles or a combination thereof.

~~20. A method of preparing a strain sensor comprising:~~

~~a. adding an elastomer to a supporting matrix to form a composite elastomer layer;~~

~~b. depositing an amount of piezoresistive element and a plurality of spacer elements on a surface of the composite elastomer layer;~~

~~c. installing electrodes connected electrically to the piezoresistive element; and~~

~~d. providing a substrate to seal in the piezoresistive element and the plurality of spacer elements.~~

20. A method according to claim 18 or 19, wherein the elastomer layer includes polydimethylsiloxane, polyurethane, polyethylene, poly (ethylene-vinyl acetate), polyvinyl chloride, polyborodimethylsiloxane, polystyrene, acrylonitrile-butadiene-styrene, styrene-butadiene-styrene, ethylene-propylene rubber, neoprene, cork, natural rubber, silicone, thermoplastic elastomeric gel, or a combination thereof.

21. A flexible strain-sensitive stretch sensor fabricated using a method according to any one of claims 18 to 20.

22. A method of fabricating a flexible strain-sensitive stretch sensor, including the steps of:

a) preparing a support matrix by attaching a non-stretchable, flexible mesh material to opposing ends of a tubular stretchable mesh material;

b) depositing elastomer material on an inner wall of the support matrix;

c) securing a first electrode to the elastomer layer at one end of the support matrix to thereby seal the one end of the support matrix;

d) depositing graphite conductive elements over the elastomer layer; and

e) securing electrodes at opposite ends of the first elastomer layer; and

f) securing a second electrode to an opposing end of the support matrix to thereby seal the opposing end of the support matrix to thereby retain the graphite conductive elements therein.

23. A method according to claim 22, wherein the graphite conductive particles includes graphene nanoparticles, carbon black, fullerene, carbon nanoparticles, graphene oxide particles, functionalized carbon-based nanomaterials, graphite particles or a combination thereof.

24. A method according to claim 22 or 23, wherein the elastomer layer includes polydimethylsiloxane, polyurethane, polyethylene, poly (ethylene-vinyl acetate), polyvinyl chloride, polyborodimethylsiloxane, polystyrene, acrylonitrile-butadiene-styrene, styrene-butadiene-styrene, ethylene-propylene rubber, neoprene, cork, natural rubber, silicone, thermoplastic elastomeric gel, or a combination thereof.

25. A flexible strain-sensitive stretch sensor fabricated using a method according to any one of claims 22 to 24.

26. A method of fabricating a multi-sensor assembly including a plurality of flexible strain-sensitive pressure sensors, including the steps of:

a) depositing an elastomer material on an elastic support layer;

b) depositing a graphite-based piezoresistive layer over different spaced apart areas on the support layer; and

c) attaching a substrate layer supporting a plurality of electrodes to the support layer

such that a plurality of the flexible strain-sensitive pressure sensors are provided within the multi-sensor assembly.

27. A method according to claim 25, wherein the piezoresistive layer includes graphene nanoparticles, carbon black, fullerene, carbon nanoparticles, graphene oxide particles, functionalized carbon-based nanomaterials, graphite particles or a combination thereof.

28. A method according to claim 26 or 27, wherein the support layer is an elastane or spandex mesh.

29. A method according to claim 26 or 27, wherein the elastomer layer and support layer is formed from the same elastomer.

30. A method according to any one of claims 26 to 29, further including depositing an intermediate adhesion layer between the elastomer layer and support layer.

31. A multi-sensor assembly fabricated using a method according to any one of claims 26 to 30.