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(54) Title: COMPRESSIBLE MULTILAYER ARTICLES AND METHOD OF MAKING THEREOF

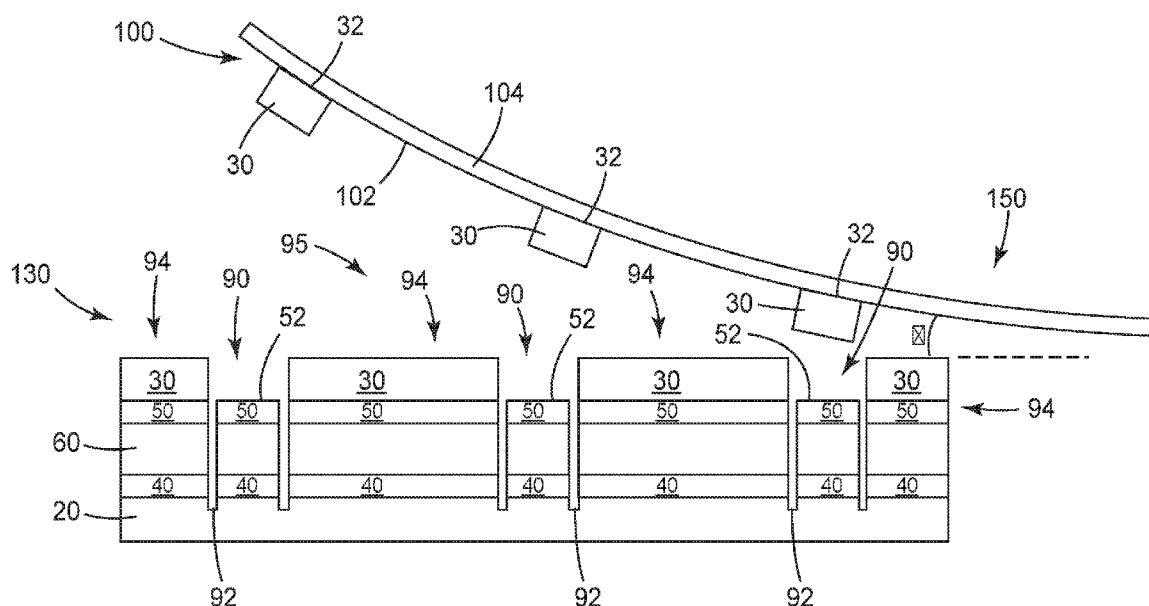


FIG. 1F-1

(57) Abstract: A method of making a compressible multilayer article includes a multilayer elastomeric laminate film article with a first adhesive tie layer on a first major surface of a first release liner; an elastomeric core layer including a cured silicone polymer onto a surface of the first adhesive tie layer; a second adhesive tie layer on a first major surface of the elastomeric core layer; and a second release liner on a major surface of the second adhesive tie layer. A selected portion of each of the second release liner, the second adhesive tie layer, the elastomeric core layer, and the first adhesive tie layer is separated from the multilayer elastomeric laminate film article to form a patterned multilayer elastomeric film article including an array compressible structures attached to the first release liner, and an array of chaff regions attached to the first release liner and interspersed between the compressible structures.

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COMPRESSIBLE MULTILAYER ARTICLES AND METHOD OF MAKING THEREOF**BACKGROUND**

5 [0001] Force-sensing capacitor elements can be used in touch displays, keyboards, touch pads, and other electronic devices. The force-sensing capacitor elements can be integrated, for example, at the periphery of or beneath a display, to sense or measure force applied to the display. The force-sensing capacitor elements can also be integrated within, for example, a touch pad, keyboard, or digitizer (e.g., stylus input device).

10 [0002] Challenges associated with the integration of force-sensing with the display of an electronic device include providing a force-sensing capacitor element with linearity of response, speed of response and speed of recovery, preservation of device mechanical robustness, preservation of device hermiticity where desired, thinness of construction, sensitivity, repeatability, lifetime, determination of position or positions of force application, and noise rejection.

15 [0003] Arrays of compressible structures in a force-sensing capacitor element can be used as “springs” during detection of the magnitude and/or direction of force or pressure applied to the display or electronic device. Arrays of compressible structures have been made by microreplication, which refers generally to a fabrication technique wherein precisely shaped topographical structures are prepared by casting or molding a polymer (or polymer precursor that is later cured to form a polymer) in a production tool, e.g. a mold, a film with cavities or an embossing tool. Arrays of compressible structures have also been made
20 using extrusion processes.

SUMMARY

25 [0004] Arrays of compressible elastomeric structures made by microreplication can include a land region between individual structures, which can impact the capacitive sensitivity of the structures and make the array excessively thick for use in some force-sensing capacitor elements. The shape and dimensions of individual compressible structures in arrays of elastomeric structures made using extrusion or molding techniques can also in some cases be difficult to consistently and accurately control.

30 [0005] In general, the present disclosure relates to compressible elastomeric structures and processes for their manufacture. For example, in some embodiments, an array of discrete individual elastomeric structures is cut from a continuous multilayer elastomeric laminate film article.

35 [0006] The multilayer elastomeric laminate film article includes an elastomeric core layer having on each opposed major surface thereof an adhesive tie layer. A first adhesive tie layer on one major surface of the elastomeric core is overlain by a first release liner. A second adhesive tie layer on the opposite major surface of the elastomeric core, which may be the same or different than the first adhesive tie layer, is overlain by a second release liner, which can be the same or different from the first release liner.

[0007] The multilayer elastomeric film article is patterned by a cutting process such as, for example, laser cutting, die cutting, or a combination thereof, to separate a chaff material from the first adhesive tie

layer, the elastomeric core layer and the second tie layer to form an array of chaff structures interspersed between an array of individual elastomeric structures. Substantially all, or a portion of, the chaff material may optionally be removed in subsequent process steps to leave behind the array of elastomeric structures. In some embodiments the elastomeric structures in the array have substantially no lands
5 between them, or no lands between them.

[0008] After the cutting step a continuous adhesive tape or an adhesive layer is laminated over the second release liner remaining on each individual elastomeric structure in the array, as well as over the array of chaff structures, to form a delivery film construction.

[0009] In some embodiments the continuous tape or adhesive layer on the delivery film construction can
10 be subsequently removed at an appropriate time during the process for manufacturing a force-sensing capacitor element to strip away the second release liner overlying the second adhesive tie layer on each individual elastomeric structure. In other embodiments, the continuous tape or adhesive layer on the delivery film construction can be subsequently removed to strip away the second release liner overlying the second adhesive tie layer on each individual elastomeric structure, as well as the array of chaff
15 structures.

[0010] The removal of the continuous tape or adhesive layer leaves behind an array of individual, land-free elastomeric structures in place on the first release liner and forms a compressible structure delivery film construction. Removal of the second release liner by the continuous tape or adhesive layer exposes a surface of the second adhesive tie layer on each individual elastomeric structure in the compressible
20 structure delivery film construction, and readies the array of structures for further processing steps.

[0011] In some embodiments, the exposed surface of the second adhesive tie layer on each individual elastomeric structure is laminated to a substrate. The first release liner can then optionally be removed from the compressible structure delivery film construction to expose the surface of the first adhesive tie layer on each individual elastomeric structure in the array, and the exposed surfaces of the first and the
25 second adhesive tie layers can then each be laminated to their respective substrates at the same time or at different times as needed.

[0012] In the process of the present disclosure the relative position of the individual elastomeric structures in the array is determined by the cutting process, and the individual elastomeric structures remain in their relative positions on the first release liner until the delivery film construction is further
30 processed. The first release liner and the second release liner remain in place until the delivery film construction is further processed, which protects the surfaces of the first and the second adhesive tie layers during all elastomeric laminate film article patterning steps, as well as during handling of the delivery film construction. The adhesive surface of the second tie layer is exposed for the first time just prior to lamination of the array of elastomeric structures to a substrate, which maintains the desired
35 adhesive properties of the bonding surfaces.

[0013] In one embodiment, the invention is directed to a method A method of making a compressible, multilayer article including:

providing a multilayer elastomeric laminate film article including:

a first adhesive tie layer on a first major surface of a first release liner;
an elastomeric core layer comprising a cured silicone polymer onto a surface of the first
adhesive tie layer;

a second adhesive tie layer on a first major surface of the elastomeric core layer; and
a second release liner on a major surface of the second adhesive tie layer;

separating a selected portion of each of the second release liner, the second adhesive tie layer, the
elastomeric core layer, and the first adhesive tie layer from the multilayer elastomeric laminate film
article to form a patterned multilayer elastomeric film article including:

an array including a plurality of discrete compressible structures attached to the first
release liner, and

an array including a plurality of chaff regions attached to the first release liner and
interspersed between the discrete compressible structures.

[0014] In another embodiment, the invention is directed to a method of making a compressible,
multilayer article including:

cutting away a portion of a multilayer elastic laminate article to form a patterned multilayer
elastomeric film article, wherein the multilayer elastic laminate film article includes:

a first release liner comprising a polymeric film,

a first adhesive tie layer on the first release liner, wherein the first adhesive tie layer
includes a silicone polyoxamide,

an elastomeric core layer on the first adhesive tie layer, wherein the elastomeric core
layer includes a silicone polymer,

a second adhesive tie layer on the elastomeric core layer, wherein the second adhesive tie
layer includes a silicone polyoxamide, and

a release liner on the second adhesive tie layer, wherein the release liner includes a
polymeric film; and

wherein the patterned multilayer elastomeric film article includes:

a first array including a plurality of discrete compressible structures attached to the first
release liner, wherein the array is free of land areas between the discrete structures, and

a second array interspersed with the first array, wherein the second array includes a
plurality of chaff regions attached to the first release liner.

[0015] In another embodiment, the present disclosures is directed to a delivery film article, including:

a first adhesive tie layer on a first release liner, wherein the first adhesive tie layer includes a
silicone polyoxamide;

a second adhesive tie layer on a second release liner, wherein the second adhesive tie layer
includes a silicone polyoxamide;

an elastomeric core layer between the first adhesive tie layer and the second adhesive tie layer,
wherein the elastomeric core layer includes a silicone polymer;

a first array including a plurality of discrete compressible structures attached to the first release liner, wherein the array is free of land areas between the discrete structures; and a second array interspersed with the first array, wherein the second array includes a plurality of chaff regions attached to the first release liner, and

5 a film including an adhesive layer contacting the second release liners attached to the discrete compressible structures and the chaff regions.

[0016] In yet another embodiment, the present disclosure is directed to a post delivery film article including an array of discrete compressible posts removably attached to a first release liner, the posts having no land areas therebetween, wherein the posts include:

10 a first adhesive tie layer on the first release liner, wherein the first adhesive tie layer includes a silicone polyoxamide;

an elastomeric core layer on the first adhesive tie layer, wherein the elastomeric core layer includes a silicone polymer;

15 a second adhesive tie layer on the elastomeric core layer, wherein the second adhesive tie layer includes a silicone polyoxamide; and

a second release liner on the second adhesive tie layer,

wherein the posts have a first end attached to the first release liner and a second end distal the first release liner, wherein the posts have a height h between the first end the second end of about 1 μm and about 1000 μm , a width w_1 at the second end of about 2 μm to about 6000 μm , a width w_2 at the first
20 end of about 2 μm to about 6000 μm , and an aspect ratio, h/w_1 , between about 0.2 to about 5.

[0017] In yet another embodiment, the present disclosure is directed to a method of making a compressible, multilayer article including:

coating a coating composition including a polysiloxane precursor resin onto a first layer of a polyoxamide adhesive on a first polymeric release liner film;

25 laminating a second layer of a polyoxamide adhesive on the coating composition to form a laminate construction, wherein the second layer of the polyoxamide adhesive is on a second polymeric release liner film;

30 heating the laminate construction to cure the polysiloxane precursor resin to form an elastomeric core layer including a cured silicone polymer, and to bond the first layer of polyoxamide adhesive and the second layer of polyoxamide adhesive to the elastomeric core layer;

cutting away, with at least one of a laser or a die, a selected portion of each of the second polymeric release liner film, the second polyoxamide adhesive layer, the elastomeric core layer, and the first polyoxamide adhesive layer to form:

35 a first array including a plurality of discrete compressible structures attached to the first polymeric release liner film, wherein the array is free of land areas between the discrete compressible structures, and

a second array interspersed with the first array, wherein the second array includes a plurality of chaff regions attached to the first polymeric release liner film; and

laminating a tape over the first array and the second array, wherein the tape includes an adhesive layer contacting the second polymeric release liner film overlying the discrete compressible structures and the chaff regions.

[0018] In yet another embodiment, the present disclosure is directed to a microstructured article, including:

a flexible first substrate; and

a plurality of discrete spaced apart individually removable posts disposed on a major surface of the first substrate, each discrete post including:

a first tie layer removably attached to the major surface of the first substrate;

an elastomeric layer disposed on the first adhesive layer; and

a second tie layer disposed on the elastomeric layer;

wherein each post is individually transferrable from the first substrate to a receiving substrate without removing any other post, the second tie layer facilitating permanent adhesion of the post to the receiving substrate.

[0019] The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF DRAWINGS

[0020] FIGS. 1A-1E, 1F-1 to 1F-4, and 1G-1 to 1G-4 are schematic cross-sectional side views of embodiments of a process for making an array of compressible elastomeric structures on a delivery film.

[0021] FIG. 2 is a schematic cross-sectional side view of a portion of an exemplary compressible multilayer article 200 according to one embodiment of the present disclosure.

[0022] FIG. 3 is a photograph of a compressible structure delivery film including an array of elastomeric structures made according to Example 1.

[0023] FIG. 4 is a photograph of an individual elastomeric structure from the compressible structure delivery film of FIG. 3.

[0024] Like symbols in the drawings are directed to like elements.

DETAILED DESCRIPTION

[0025] FIG. 1 is a schematic illustration of a portion of a process 10 for making an array of compressible elastomeric structures. In step A, the process 10 includes selection of a continuous first release liner 20 and a second release liner 30, which can protect underlying adhesive tie layers during handling and can be easily removed, when desired, for transfer to a substrate of all or a part of a delivery film construction or a compressible structure delivery film construction including the array of compressible elastomeric structures.

[0026] The release liners 20, 30 may be flexible or rigid, and preferably are flexible. In various embodiments, the release liners 20, 30 are about 0.5 mils (0.01 mm) thick to about 20 mils (0.5 mm) thick. Suitable materials that can function as a rigid liner include metals, metal alloys, metal-matrix composites, metalized plastics, inorganic glasses and vitrified organic resins, formed ceramics, and polymer matrix reinforced composites. In various embodiments the first release liner 20 and the second release liner 30, which may be the same or different, are selected from flexible paper and polymeric films having sufficient dimensional stability to hold layers and structures formed thereon in position relative to one another without excessive stretching.

[0027] Suitable paper liners include, but are not limited to, densified Kraft paper (commercially available from, for example, Loparex North America, Willowbrook, IL), poly-coated paper such as polyethylene coated Kraft paper, and the like.

[0028] Suitable polymeric film/liners include, but are not limited to, thermoplastic polymer films including polyalkylenes, e.g. polyethylene and polypropylene; polybutadiene, polyisoprene; polyalkylene oxides, e.g. polyethylene oxide; polyesters, e.g. PET and PBT; polyamides; polycarbonates, polystyrenes, block copolymers of any of the preceding polymers, and combinations thereof. Other suitable polymeric materials include polyimide, polysilicone, polytetrafluoroethylene, polyethylenephthalate, polyvinylchloride, or combinations thereof. Polymer blends of any of the above may also be employed, and nonwoven or woven liners may also be used.

[0029] In some embodiments, the release liners 20, 30 are selected from materials that provide opposed major surfaces 21, 22 and 31, 32 with varying release values. In this application release value refers to the relative ease or difficulty with which a selected coated material can be peeled away and separated from the surface of the release liner. For example, in some embodiments, the release value of the a first major surface 21 of the first release liner 20 is greater than the release value of the first major surface 31 of the second release liner 30, which in this application means that materials should be selected from the release liners 20, 30 such that it is more difficult to remove an adhesive layer adjacent the first major surface 21 of the first release liner 20 than to remove an adhesive layer from the first major surface 31 of the second release liner 30. Put another way, in some embodiments, materials should be selected for the release liners 20, 30 such that adhesive layers adhere more strongly to the first major surface 21 of the first release liner 20 than to the first major surface 31 of the second release liner 30. In other embodiments, materials may be selected from the first major surface 21 of the first release liner 20 and the first major surface of the second release liner 30 such that the release values for a selected adhesive material are the substantially similar or the same.

[0030] Release liner materials, release coatings, and combinations thereof should be selected such that separation of the release liner from an adhesive on the major surfaces 21, 22 and 31, 32 does not negatively alter the surface topology of the adhesive layer.

[0031] In some embodiments, any or all of the major surfaces of the release liners 20, 30 may include a release coating, which may be the same or different, to tune or otherwise modify their release values. In various embodiments, which are not intended to be limiting, the release coatings applied to the major

surfaces 21, 22 and 31, 32 of the release liners 20, 30 may be selected from a fluorine-containing material, a silicone-containing material, a fluoropolymer, a silicone polymer, or a poly(meth)acrylate ester derived from a monomer including an alkyl (meth)acrylate having an alkyl group with 12 to 30 carbon atoms. In one embodiment, the alkyl group on the alkyl (meth)acrylate can be branched.

5 Illustrative examples of useful fluoropolymers and silicone polymers can be found in U.S. Pat. No. 4,472,480 (Olson), U.S. Pat. No. 4,567,073 and U.S. Pat. No. 4,614,667 (both Larson et al.). Illustrative examples of useful poly(meth)acrylate esters can be found in U.S. Pat. Appl. Publ. No. 2005/118352 (Suwa).

[0032] In some embodiments, at least one of the major surfaces 21, 22 and 31, 32 of the release liners 20, 10 30 may be a textured surface that modifies the release properties of the surfaces 21, 22 and 31, 32. The textured surfaces may be formed by, for example, micro-replication techniques, embossing techniques, coating techniques including, but not limited to, bead coating, and combinations thereof. Micro-replication techniques are disclosed in U.S. Patent Nos. 6,285,001; 6,372,323; 5,152,917; 5,435,816; 6,852,766; 7,091,255 and U.S. Patent Application Publication No. 2010/0188751, all of which have been 15 incorporated herein by reference in their entirety.

[0033] In step 1B, the process 10 includes coating a first adhesive tie layer 40 on the first major surface 21 of the first release liner 20, and coating a second adhesive tie layer 50 on the first major surface 31 of the second release liner 30. Following the coating step, a second major surface 42 of the first adhesive tie layer 40 contacts the first major surface 21 of the first release liner 20, and a second major surface 52 of 20 the second adhesive tie layer 50 contacts the first major surface 31 of the second release liner 30.

[0034] Coating techniques that may be used to apply the tie layers include, but are not limited to, roll coating, spray coating, knife coating, die coating, Meyer rod coating, and the like. In other embodiments, the coating composition used to form the tie layers may be extruded onto the surfaces of the release liners. A specific coating technique is selected based on a variety of factors, including but not limited to, the 25 material being coated, the desired final coating thickness, process consideration, e.g. continuous or batch, and the like. The coating compositions utilized to form the first and the second adhesive tie layers can be applied to a substrate under ambient conditions but may also be applied under conditions of elevated temperature (e.g. 30-70°C). Depending on the material being coated, it can be coated with or without solvent added as a diluent or viscosity modifier. Following the coating step in FIG. 1B, in various 30 embodiments the coating compositions may optionally be dried or cured prior to subsequent process steps.

[0035] The first adhesive tie layer 40 and the second adhesive tie layer 50 may be the same or different, and can each include a wide variety of adhesives known in the art. Suitable adhesives for the adhesive tie layers 40, 50 may be selected from any adhesive that can be applied on an adjacent silicone layer and can 35 adequately adhere to a wide variety of target substrates. In one embodiment, which is not intended to be limiting, the first and the second tie layers include silicone thermoplastic elastomers, including, but not limited to polydiorganosiloxane polyoxamide, linear block copolymers, i.e. silicone polyoxamide, such as those disclosed in U.S. Pat. Nos. 7,371,464 (Sherman, et. al.) and 7,501,184 (Leir, et. al.), which are each

incorporated herein by reference in their entirety. The molecular weight of the thermoplastic elastomers is not particularly limited, and in some embodiments the number average molecular weight of the thermoplastic elastomers is between about 2000 g/mol and 1,200,000 g/mole, between about 2000 g/mol and 750,000 g/mole, between about 2000 g/mol and 500,000 g/mole or even between about 2000 g/mol and 250,000 g/mole.

[0036] The thickness of the first adhesive tie layer 40 and the second adhesive tie layer 50 may be the same or different, and in some non-limiting embodiments the layers 40, 50 have a thickness of less than about 1 μm to about 12 μm , or about 3 μm to about 12 μm .

[0037] Referring to FIG. 1C, in the process 10 a coating composition including a polysiloxane precursor resin is applied on one or both of a first major surface 41 of the first adhesive tie layer 40, or a first major surface 51 of the second adhesive tie layer 50. The resulting construction is then laminated and cured to form a multilayer elastomeric laminate film article 70 including a first adhesive tie layer 40, a second adhesive tie layer 50, and an elastomeric core layer 60 there between. In another embodiment, the coating composition including the polysiloxane precursor resin is applied on one or both of the first major surfaces 41 of the first adhesive tie layer 40, or the first major surface 51 of the second adhesive tie layer 50, and cured. Following the curing step, the first adhesive tie layer 40, the second adhesive tie layer 50, and the cured elastomeric core layer 60 can be laminated together to form the multilayer elastomeric laminate film article 70.

[0038] Any suitable coating technique can be used to apply the coating composition that forms the elastomeric core layer 60 including, for example, roll coating, spray coating, knife coating, die coating, Meyer rod coating and the like, and the coating composition is can be applied under ambient conditions or at elevated temperature (e.g. 30-70°C).

[0039] The coating composition that forms the elastomeric core layer 60 includes a polysiloxane precursor resin selected from at least one of a silicone elastomer or a silicone thermoplastic elastomer (generally referred to herein as a silicone polymer) that has good adhesion to the adhesive tie layers 40, 50 after cure.

[0040] In some embodiments, the silicone polymer that forms the elastomeric core layer 60 has a glass transition temperature less than about -20 °C, less than about -30 °C, less than about -40 °C, or even less than about -50 °C. In some embodiments, the silicon polymer has a glass transition temperature of greater than -150 °C, or between about -150 °C and about -20 °C, between about -150 °C and about -30 °C, between about -150 °C and about -40 °C or even between about -150 °C and about -50 °C. In some embodiments, a silicone polymer with a glass transition temperature well below room temperature is preferred, as the silicone polymer will then be in the rubbery state, as opposed to a glassy state, under normal use conditions. A silicone polymer in the rubbery state will have a lower compression modulus compared to a silicon polymer in the glass state. The lower compression modulus will lead to a lower force required to compress the elastomeric core layer 60 and thus a compressible multilayer article including the elastomeric core layer itself.

[0041] The silicone polymer selected for the elastomeric core layer 60 should have a rapid, elastic recovery and little viscous dissipation or loss. The ratio of the viscous loss to elastic recovery can be related to the value of the tan delta in a conventional dynamic mechanical thermal analysis test (DMTA). In some embodiments, the tan delta ($\tan(\delta)$) of the silicone polymer in the elastomeric core layer 60 is less than 0.12, or less than 0.15, or less than 0.30, or less than 0.50, or less than 0.65, or less than 2.04, all measured over a temperature range of -30°C to 60 °C and a frequency range between 0.01 Hz and 1 Hz.

[0042] Suitable silicone elastomers that may be cured to form the elastomeric core layer 60 include polysiloxanes, including, but not limited to polydimethylsiloxane, polymethylhydrosiloxane, polymethylphenylsiloxane, polysiloxane copolymers, and polysiloxane graft copolymers. The polysiloxanes may be cured by known mechanisms including, but not limited to, addition cure systems, e.g. platinum based cure systems; condensation cure systems, e.g. tin based cure systems, and peroxide based cure systems.

[0043] Suitable silicone elastomers that may be cured to form the elastomeric core layer 60 include, but are not limited to, polydiorganosiloxane polyoxamide, linear, block copolymers, i.e. silicone polyoxamide, such as those disclosed in U.S. Pat. Nos. 7,371,464 (Sherman, et. al.) and 7,501,184 (Leir, et. al.), which are incorporated herein by reference in their entirety.

[0044] In some embodiments, the coating composition used to form the elastomeric core layer 60 includes an optional tackifier to enhance adhesion to the adhesive tie layers 40, 50.

[0045] In some embodiments, the coating composition used to form the elastomeric core layer 60 includes other additives such as curing agents, foaming agents and the like. In some embodiments, the coating composition including the polysiloxane precursor resin may include one or more solvents to lower its viscosity. The solvent may be removed from the coating composition by drying at ambient or elevated temperatures, and the polysiloxane precursor resin may then be cured to form a cured, silicone elastomer. In some embodiments, if the molecular weight of the polysiloxane precursor resin is sufficiently low, the polysiloxane precursor resin may be coated without a solvent.

[0046] In some embodiments, the silicone elastomer or silicone thermoplastic elastomer may be cured to form a foamed elastomeric core layer 60. In some embodiments, the cured elastomeric core layer 60 has a porosity of from about 20 percent to about 80 percent, from about 25 percent to about 80 percent, from about 30 percent to about 80 percent, from about 20 percent to about 75 percent, from about 25 percent to about 75 percent, from about 30 percent to about 75 percent, from about 20 percent to about 70 percent, from about 25 percent to about 70 percent or even from about 30 percent to about 70 percent.

[0047] As noted above, the coating composition including the polysiloxane precursor resin may be coated on at least one of the first major surface 41 of the first adhesive tie layer 40, or on the first major surface 51 of the second adhesive tie layer 50, and the resulting laminate is heated to at least partially cure the coating composition and form the elastomeric core layer 60. During the lamination step, the elastomeric core layer 60 is also adhered to the first adhesive tie layer 40 and the second adhesive tie layer 50 to form a multilayer elastomeric laminate film article 70 as shown in FIG. 1C.

[0048] Suitable lamination techniques used to form the multilayer laminate article 70 can include batch and continuous processes, or a combination thereof. A batch process may involve a conventional heated press, wherein two or more substrates to be laminated are stacked within the press with the appropriate surfaces facing one another. Heat and/or pressure may then be applied to the substrates for the required time, which laminates the substrates together. A continuous laminating process may include running continuous films of two or more substrates, with their appropriate surfaces facing one another, through a pair of cylindrical rolls. A constant force may be applied to the rolls, which creates a constant pressure applied to the substrate surfaces as they pass between the rolls, or the rolls may be set to have a constant nip, i.e. gap, which also creates a force and subsequent pressure on the substrates as they proceed through the nip of the rolls. One or both of the rolls may be heated to a desired temperature to facilitate the lamination process.

[0049] Thermal or actinic radiation may be used to cure or dry the elastomeric core layer 60, and useful processes include, but are not limited to, ultraviolet (UV), e-beam curing, and the like. The resulting cured elastomeric core layer 60 has a thickness of about 12 μm to about 500 μm and forms the bulk of the thickness of the multilayer elastomeric laminate film article 70.

[0050] Referring to FIG. 1D, in the process 10 the multilayer elastomeric film article 70 is patterned by cutting away to separate a chaff material from the second release liner 30, the second adhesive tie layer 50, the elastomeric core layer 60, and the first adhesive tie layer 40. The cutting process forms a patterned multilayer elastomeric film article 80, which includes an array of chaff material interspersed with an array of discrete compressible structures 90 on the first release liner 20. In some embodiments the cutting process can optionally cut into the first release liner 20, but following completion of the cutting process the first release liner 20 should remain substantially intact to support the array of the compressible structures 90 during subsequent processing steps.

[0051] Suitable cutting processes that can be used to separate the chaff material and form the array of compressible structures 90 include, but are not limited to, laser cutting, die cutting, or a combination thereof. Following the cutting step in which the array of compressible structures 90 is formed, all or a portion of the array of chaff material can optionally be removed from the array of compressible structures 90 by, for example, vacuum, an air knife, or a combination thereof. Each structure 90 formed on the first release liner 20 by the cutting process includes a first adhesive tie layer 40, an elastomeric core layer 60, a second adhesive tie layer 50, and a second release liner 30.

[0052] The second release liner 30 remains in place on top of the array of compressible structures 90 during and after the cutting step to protect the second adhesive tie layer 50 during subsequent storage and handling. In some embodiments when laser cutting is used to form the array of compressible structures 90, the second release liner 30 may also protect the second adhesive layer 50 from contamination caused by ablated debris from the laser cutting process. If the second release liner 30 is removed from the second adhesive tie layer 50 before laser cutting, the adhesive surface 52 can in some cases become contaminated with debris from the cutting process and may in some cases not properly adhere to a target substrate in subsequent lamination steps.

[0053] As described in more detail below, the process of the present disclosure provides a method for quickly and efficiently removing the second release liner 30 from the second adhesive tie layer 50 so that the adhesive surface 52 is exposed just prior to adhering the adhesive surface 52 to a target substrate.

[0054] Following removal of the debris between the compressible structures 90, an array of void regions 92 surround each of the compressible structures 90. The void regions 92 lie between the compressible structures 90 and the array of chaff regions 94 that remain in position on the first release liner 20 following the cutting step. The array of chaff regions 94 is interspersed between the array of compressible structures 90. The chaff regions 94 include, on the first release liner 20, a first adhesive tie layer 40, an elastomeric core layer 60, a second adhesive tie layer 50, and a second release liner 30.

[0055] Referring to FIG. 1E, a continuous cap removal film 100 is laminated using one or more of the lamination processes described above onto the patterned multilayer elastomeric film article 80 to form a delivery film article 120. In the embodiment shown in FIG. 1E, the cap removal film 100 on the delivery film article 120 is an adhesive tape including an adhesive layer 102 on a first major surface 103 of an optional backing 104. In other embodiments, the continuous cap removal film 100 can include additional layers above or between the optional backing 104 and the adhesive layer 102 including, for example, adhesive layers, tie layers, release liners and the like (not shown in FIG. 1E).

[0056] Following the lamination step in FIG. 1E, the cap removal film 100 continuously overlies the array of chaff regions 94, the array of void regions 92, and the array of compressible structures 90. The adhesive layer 102 contacts a second major surface 32 of the second release liner 30 on each element in the array of chaff regions 94 and in each element in the array of compressible structures 90.

[0057] Referring to Figure 1F-1, the process 10 further includes a weeding step in which the continuous cap removal film 100 is peeled away from the delivery film article 120. When the continuous cap removal film 100 is peeled away, the continuous cap removal film 100 adheres to and removes selected portions of the second release liner 30 and leaves behind an array of discrete, spaced apart compressible structures 90 on the first release liner 20, which creates a compressible structure delivery film article 130. In some embodiments, the compressible structures 90 in the array have no land areas between them, and the surface 22 (FIG. 1A) of the first release liner 20 is exposed between individual structures.

[0058] In the embodiment of FIG. 1F-1, the cap removal film 100 is peeled away and separated from the delivery film article 130. The adhesive layer 102 on the cap removal film 100 adheres to portions of the second major surface 32 of the second release liner 30 overlying the compressible structures 90 in the array 95. The portions of the second release liner 30 overlying the compressible structures 90 are thus removed and form a weed portion 150, leaving behind a compressible structure delivery film construction 130. The weed portion 150 includes the cap removal film 100 and the portions of the second release liner 30 originally overlying the compressible structures 90. The removal of the weed portion 150 leaves behind an array of individual, land-free elastomeric compressible structures 90 in place on the first release liner 20, which is interspersed with an array of chaff regions 94. An individual structure 90 in the delivery film construction 130 and the weed portion 150 removed to create the structure 90 are shown in FIG. 1F-2.

[0059] The weed portion 150 can be removed at an appropriate time to expose the adhesive surface 52 of the second adhesive tie layer 50 on each individual elastomeric structure 90 in the array 95 for a subsequent bonding step to a selected substrate 97 (FIG. 1F-3). Following this initial bonding step, the chaff regions 94 can subsequently be removed along with the first release liner 20, which exposes the adhesive surfaces 42 on the compressible structures 90 (FIG. 1F-4).

[0060] While not wishing to be bound by any theory, presently available evidence indicates that when the cap removal film 100 is peeled away, the selective removal of the portion of the second release liner 30 overlying the compressible structures 90, while leaving behind the portions of the second release liner 30 overlying the chaff portions 94, can be the result of selection of appropriate adhesive and release liner materials, as well as one or more different peel and release surface effects simultaneously occurring at the various interfaces in the delivery film article 120. For example, the adhesive layer 102 has a first peel adhesion (measured, for example by methods such as those outlined in ASTM D3330) with respect to the second major surfaces 32 of the second release liners 30 on the chaff regions 94 and on the compressible structures 90. When the cap removal film 100 is peeled away, since the area of the portions of the second release liner 30 overlying the compressible structures 90 is significantly greater than the area of the portions of the second release liner 30 overlying the chaff regions 94, the peel adhesion between the adhesive layer 102 and the second major surfaces 32 of the second release liners 30 overlying the compressible structures 90 is greater than the peel adhesion between the adhesive layer 102 and the second major surfaces of the second release liners 30 overlying the chaff regions 94. In addition, when the cap removal film 120 is peeled away, in some embodiments test conditions such as the peel angle θ , the peel removal rate, temperature and relative humidity, and conditioning of the delivery article 120 cause release of the adhesive bond at the interface between the adhesive layer 102 and the portions of the second release liner 30 overlying the chaff regions 94, but is insufficient to overcome the adhesive bond at the interface between the surface 32 of the second release liner 30 and the adhesive layer 102.

[0061] In the embodiment of FIG. 1G-1, when the when the cap removal film 100 is peeled away and separated from the delivery film article 120, the adhesive layer 102 on the cap removal film 100 adheres to the portions of the second major surface 32 of the second release liner 30 overlying the array of compressible structures 90, as well as the portions of the second release major surfaces 32 of the second release liner 30 overlying the chaff regions 94 – the adhesive layer 102 adheres to the entire major surface 32 of the second release liner 30. The portion of the second release liner 30 overlying both the compressible structures 90 and the chaff portions 94 is thus removed and forms a weed portion 152, leaving behind a compressible structure delivery film construction 132 including an array 99 of discrete, post-like compressible structures 90. The weed portion 152 includes the cap removal film 100 and the portions of the second release liner 30 originally overlying the compressible structures 90, as well as the chaff portions 94 originally interspersed between the compressible structures 90.

[0062] The weed portion 152 can be removed at an appropriate time to expose the adhesive surface 52 of the second adhesive tie layer 50 on each individual elastomeric structure 90 in the array 99, leaving behind an array of discrete elastomeric compressible structures 90 in place on the first release liner 20.

An individual structure 90 in the delivery film construction 132 and the weed portion 152 removed to create the structure 90 are shown in FIG. 1G-2.

[0063] Referring to FIG. 1G-3, in a subsequent bonding step the adhesive surfaces 52 on the compressible structures 90 can be bonded to a selected substrate 97 (FIG. 1G-3). The first release liner 20 can subsequently be removed to expose the adhesive surfaces 42 on the compressible structures 90 (FIG. 1G-4).

[0064] While not wishing to be bound by any theory, presently available evidence indicates that when the cap removal film 100 is peeled away from the delivery film article 120, the selective removal of the portions of the second release liner 30 overlying the compressible structures 90 along with the portions of the second release liner 30 overlying the chaff portions 94, can be the result of one or more different peel and release surface effects simultaneously occurring at the various interfaces in the delivery film article 120.

[0065] For example, on the array of compressible structures 90, a first peel adhesion between the adhesive layer 102 and the second major surface 32 of the second release liner 30 (measured, for example by methods such as those outlined in ASTM D3330) is greater than a second peel adhesion between the first major surface 31 of the second release liner 30 and the second major surfaces 52 of the second adhesive tie layers 50. When the cap removal film 100 is peeled from the delivery film article 120, this differential between the first peel adhesion and the second peel adhesion causes the first major surface 31 of the second release liner 30 to separate from the second major surface 52 of the second adhesive tie layer 50 on the compressible structures 90. This separation between the second release liner 30 and the second adhesive tie layer 50 exposes the adhesive on the second major surface 52 of the second adhesive tie layer 50 on each of the compressible structures in the array.

[0066] On the array of compressible structures 90, the first peel adhesion between the adhesive layer 102 and the second major surface 32 of the second release liner 30 is lower than a third peel adhesion between the first major surface 21 of the first release liner 20 and the second major surface 42 of the first adhesive tie layer 40. When the cap removal film 100 is peeled away from the delivery film article 120, this differential between the first peel adhesion and the third peel adhesion is insufficient to cause the second major surface 42 of the first adhesive tie layer 40 to separate from the first major surface 21 of the first release liner 20 on the compressible structures 90 in the array.

[0067] The contact area between the second major surfaces 32 of the second release liner 30 on the chaff regions 94 is smaller than the contact area of the second major surfaces 32 of the second release liners 30 on the compressible structures 90. In the embodiment of FIG. 1F, when the cap removal film 100 is peeled from the delivery film article 120, the differential between the first peel adhesion and the second peel adhesion is insufficient to separate the first major surfaces 31 of the second release liner 30 from the second major surfaces 52 of the second adhesive tie layers 50, and the second release liners 30 remain attached to the second adhesive tie layers 50 in the chaff regions 94.

[0068] The area of the second major surfaces 42 of the first adhesive tie layer 40 on the chaff regions 94 is smaller than the area of the first major surfaces 42 of the first adhesive tie layer 40 on the compressible

structures 90. When the cap removal film 100 is removed from the delivery film article 120, the differential between the first peel adhesion between the adhesive layer 102 and the second major surface 32 of the second release liner 30 is greater than the third peel adhesion between first major surface 21 of the first release liner 20 and the second major surface 42 of the first adhesive tie layer 40 on the chaff regions 94. When the cap removal film 100 is peeled from the delivery film article 120, this differential between the first peel adhesion the third peel adhesion causes the first major surface 21 of the first release liner 20 to separate from the second major surface 42 of the first adhesive tie layer 40 on the chaff regions 94.

[0069] In addition to the relative adhesive bonds at the interfaces in the delivery film article 120, presently available evidence further indicates that conditions such as the peel angle θ , the peel removal rate, temperature and relative humidity, and conditioning of the delivery article 120 can impact the release of the weed portion 152 from the compressible structure delivery film construction 132 in FIG. 1G. For example, the peel angle θ can readily overcome the adhesive bond at the interface surface 42 between the portions of the first tie layer 40 underlying the chaff portions 94 and the first release liner 20. Since no adhesive is present on the side wall surfaces 43 of the first adhesive tie layer 40, on the side wall surfaces 61 of the elastomeric core region 60, or on the side wall surfaces 53 of the second adhesive tie layer 50, once the adhesive bond at the interface surface 42 is overcome, the chaff regions 94 remain adhered to the adhesive layer 102 at the interface surfaces 32 of the second release liner 30, and readily release from the compressible structures 90. The attachment between the adhesive layer 102 and the portions of the second release liner 30 overlying both the chaff regions 94 and the compressible structures 90 allows removal of the chaff regions 94 at the same time the adhesive surfaces 52 are exposed on the compressible structures 90, and forms a weed portion 152 including the cap removal film 100, the portions of the second release liner 32 overlying the adhesive surfaces 52, and the chaff portions 94.

[0070] While the discrete elastomeric compressible structures 90 in the embodiment of FIG. 1 are posts with a generally rectangular cross-sectional shape when view from above in the x-z plane, the shapes of the discrete compressible structures 90 in the array is not particularly limited. The compressible structures 90 may have cross-sectional shapes in the x-z plane including, but not limited to, circular, elliptical, polygonal (pentagonal, hexagonal, octagonal). The compressible structures 90 may be pyramidal or truncated pyramidal, wherein the pyramidal shape may include between 3 to 10 sidewalls; cuboidal; e.g. square cube or rectangular cuboid; conical; truncated conical, annular, spiral and the like. Combinations of shapes may be used. In some embodiments, the compressible structures may be posts with a circular cross section when viewed in the x-z plane, and have an hourglass shape when viewed in the x-y plane.

[0071] In various embodiments, the height, h , of the discrete compressible structures 90 in the array on the first release liner 20 (for example, along the x-direction in FIG. 1), which include the first adhesive tie layer 40, the elastomeric core layer 60, and the second elastomeric tie layer 50, is between about 1 μm and about 1000 μm , between about 5 μm and about 1000 μm , between about 10 μm and about 1000 μm , between about 50 μm and about 1000 μm , 1 μm and about 750 μm , between about 5 μm and about 750

μm , between about 10 μm and about 750 μm , between about 50 μm and about 750 μm , 1 μm and about 500 μm , between about 5 μm and about 500 μm , between about 10 μm and about 500 μm , between about 50 μm and about 500 μm , 1 μm and about 250 μm , between about 5 μm and about 250 μm , between about 10 μm and about 250 μm or even between about 50 μm and about 250 μm .

[0072] In various embodiments, the width, w_1 , of the top of the discrete compressible structures 90 distal the first release liner 20 is between about 2 μm and about 6000 μm , between about 10 μm and about 6000 μm , between about 20 μm and about 6000 μm , between about 100 μm and about 6000 μm , between about 2 μm and about 4000 μm , between about 10 μm and about 4000 μm , between about 20 μm and about 4000 μm , between about 100 μm and about 4000 μm , between about 2 μm and about 2000 μm , between about 10 μm and about 2000 μm , between about 20 μm and about 2000 μm , between about 100 μm and about 2000 μm , between about 2 μm and about 1000 μm , between about 10 μm and about 1000 μm , between about 20 μm and about 1000 μm or even between about 10 μm and about 1000 μm .

[0073] In some embodiments in which laser cutting is used to form the chaff regions, the width, w_2 , of the base of the discrete compressible structures 90 attached to the first release liner 20 is slightly greater than the width w_1 of the top, and can vary based on the cutting process used to form the compressible structures 90. In various embodiments, the width, w_2 of the base of the discrete compressible structures 90 is between about 2 μm and about 6000 μm , between about 10 μm and about 6000 μm , between about 20 μm and about 6000 μm , between about 100 μm and about 6000 μm , between about 2 μm and about 4000 μm , between about 10 μm and about 4000 μm , between about 20 μm and about 4000 μm , between about 100 μm and about 4000 μm , between about 2 μm and about 2000 μm , between about 10 μm and about 2000 μm , between about 20 μm and about 2000 μm , between about 100 μm and about 2000 μm , between about 2 μm and about 1000 μm , between about 10 μm and about 1000 μm , between about 20 μm and about 1000 μm or even between about 10 μm and about 1000 μm .

[0074] The relationship between w_1 and w_2 for the compressible structures 90 can vary widely and can depend on a number of factors such as, for example, the materials used, whether the structures are laser-cut or die-cut, the release liner 30 material and thickness, and laser type and power for laser-cut structures. For example, in some embodiments die-cut structures are hourglass shaped when viewed along the x-y plane in FIG. 1, where the $w_1 = w_2$, but the middle of the post is narrower than either w_1 or w_2 , or both.

[0075] In various embodiments, the aspect ratio, h/w_1 , of the of the discrete compressible structures 90 on the first release liner 20 is between about 0.05 to about 1, between about 0.2 to about 5, between about 0.2 to about 3, between about 0.2 to about 2, between about 0.2 to about 1, between about 0.3 to about 5, between about 0.3 to about 3, between about 0.3 to about 2, between about 0.3 to about 1, between about 0.4 to about 5, between about 0.4 to about 3, between about 0.4 to about 2, between about 0.4 to about 1.

[0076] The discrete compressible structures 90 may be arranged randomly in the array across the first release liner 20 or may be arranged in a pattern, e.g. a repeating pattern. Patterns include, but are not limited to, square arrays, hexagonal arrays and the like when viewed in, for example, the yz-plane of FIG.1. Combination of patterns may be used.

[0077] The discrete compressible structures 90 in the array on the first release liner 20 may also be arranged in continuous or discontinuous lines (for example, along the z-direction in FIG. 1). The lines may be straight, curved or wavy and may be parallel, randomly spaced or placed in a pattern.

Combinations of different line types and patterns may be used. The cross-sectional shape (the cross-section defined by a plane perpendicular to the length) of the lines is not particularly limited and may include, but is not limited, to triangular, truncated triangular, square, rectangular, trapezoidal, hemispherical and the like. Combinations of different cross-sectional shapes may be used.

[0078] The lengths l of the discrete compressible structures 90 in the array on the first release liner 20 is not particularly limited. Although not shown in FIG. 1, the lengths of these structures would be measured along the z-direction. The lengths l may be as long as the length of the compressible multilayer article.

[0079] In various embodiments, the heights h of the discrete compressible structures 90 may all be the same or may be different. In various embodiments, the widths w_1 and w_2 of the discrete compressible structures 90 may all be the same or may be different. The lengths l of the discrete compressible structures 90 may all be the same or may be different.

[0080] When the second release liner 30 is removed, the exposed adhesive bonding surface 52 of the second adhesive tie layer 50 is substantially planar, which has heretofore been difficult to achieve using microreplication and molding processes. A substantially flat adhesive bonding surface 52 can provide the highest possible surface area for a more stable and permanent bond to an electrode construction, and provide a force-sensing capacitor element capable of more accurately detecting and measuring the magnitude and/or direction of force or pressure applied to a display or electronic device. For example, in some embodiments the adhesive bonding surface 52 varies less than about 5% of the aspect ratio, or less than about 3% of the aspect ratio, or less than about 2% of the aspect ratio. The first release liner 20 can be removed from the compressible structure delivery film construction 130 (not shown in FIG. 1, but shown removed in FIG. 1G-4) to expose the second major surface 42 the first adhesive tie layer 40 on each individual elastomeric structure 90 in the array. The adhesive bonding surface 52 of the second adhesive tie layer 50 and the adhesive bonding surface 42 of the first adhesive tie layer can then be laminated to an electrode assembly as needed so that the array of compressible structures 90 forms a component of a force-sensing capacitor element.

[0081] FIG. 2 is a schematic cross-sectional side view of a portion of an exemplary compressible multilayer article 200 according to one embodiment of the present disclosure, which forms a component of a force-sensing capacitor element for use in, for example, a display in an electronic device. However, it should be emphasized that the compressible multilayer articles described in this application can be attached to or incorporated within any type of substrate, and as such the description of FIG. 2 is only an example and is not intended to be limiting. In FIG. 2 the compressible multilayer article 200 includes an elastomeric core layer 260, having a first major surface 261 and a second major surface 292. The article 200 further includes a first adhesive tie layer 240, having a first major surface 241 and a second major surface 242. The first major surface 241 of first tie-layer 240 is in contact with and adhered to the first major surface 261 of the elastomeric core layer 260. The compressible multilayer article 20 further

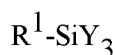
includes a second adhesive tie layer 250, having a first major surface 251 and a second major surface 252. The first major surface 251 of the second adhesive tie layer 250 is in contact with and adhered to the second major surface 262 of the elastomeric core layer 260.

[0082] In some embodiments, the compressible multilayer article 200 further includes a first primer layer 270, wherein the first primer layer 270 is in contact with at least a portion of the second major surface 242 of first tie-layer 240, and a second primer layer 272, wherein second primer layer 272 is in contact with at least a portion of the second major surface 252 of the second tie-layer 250.

[0083] The first and second primer layers 270, 272 may include, but are not limited to, at least one of silicone thermoplastic elastomer, e.g., silicone polyoxamide, olefin and styrene based block copolymer, e.g. styrene-ethylene-butadiene-styrene and styrene-isoprene-styrene, polyacrylates, e.g. polyester acrylate and polyurethane acrylate, fumed silica, functionalized fumed silica, silanes, titanates, zirconates and siloxanes. Combinations of these materials may be used.

[0084] The first and second primer layers include a silicone thermoplastic elastomer, e.g. polydiorganosiloxane polyoxamide, linear, block copolymers, i.e. silicone polyoxamide, such as those disclosed in U.S. Pat. Nos. 7,371,464 (Sherman, et. al.) and 7,501,184 (Leir, et. al.), which have been previously been incorporated herein by reference in their entirety. The first and second primer layers that include a silicone thermoplastic elastomer also include a coupling agent. Useful coupling agents include, but are not limited to silane coupling agents (e.g., organotrialkoxysilanes), titanates, zirconates, and organic acid-chromium chlorides coordination complexes. Organosilanes are particularly useful coupling agents.

[0085] In some embodiments, the coupling agent includes an organosilane coupling agent represented by the formula:



wherein R^1 is a monovalent organic group and each Y is independently a hydrolyzable group. In some embodiments, R^1 has from 2 to 18 carbon atoms. In some embodiments, R^1 has from 3 to 12 carbon atoms and is selected from the group consisting of epoxyalkyl groups, hydroxyalkyl groups, carboxyalkyl groups, aminoalkyl groups, acryloxyalkyl groups, and methacryloxyalkyl groups. In some embodiments, each Y is independently selected from the group consisting of -Cl, -Br, $-OC(=O)R^2$, and OR^2 , wherein R^2 represents an alkyl group having from 1 to 4 carbon atoms.

[0086] Suitable silane coupling agents include, for example, those identified in U.S. Pat. No. 3,079,361 (Plueddemann). Specific examples include: (3-acryloxypropyl)trimethoxysilane, N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, 3-aminopropyltrimethoxysilane, (3-glycidoxypropyl)trimethoxysilane, 3-mercaptopropyltrimethoxysilane, 3-methacryloxypropyltrimethoxysilane, vinyltrimethoxysilane (all available from Gelest, Inc., Morrisville, Pennsylvania), and those available under the trade designation "XIAMETER" from Dow Corning Corp., Midland, Michigan such as vinylbenzylaminoethylaminopropyltrimethoxysilane (supplied as 40% in

methanol, XIAMETER OFS-6032 SILANE), chloropropyltrimethoxysilane (XIAMETER OFS-6076 SILANE), and aminoethylaminopropyltrimethoxysilane (XIAMETER OFS-6094 SILANE).

[0087] Suitable titanate coupling agents include, for example, those identified in U.S. Patent No. 4,473,671 (Green). Specific examples include isopropyl triisostearoyl titanate, isopropyl tri(lauryl-myristyl) titanate, isopropyl isostearoyl dimethacryl titanate; isopropyl tri(dodecyl-benzenesulfonyl) titanate, isopropyl isostearoyl diacryl titanate, isopropyl tri(diisooctyl phosphato) tri(dioctylpyrophosphato) titanate, isopropyl triacryloyl titanate, and diisopropoxy(ethoxyacetoacetyl) titanate, tetra(2,2-diallyloxymethyl)butyl di(ditridecyl)phosphito titanate (available as KR 55 from Kenrich Petrochemicals, Inc. (hereinafter Kenrich) Bayonne, New Jersey), neopentyl(diallyl)oxy trineodecanonyl titanate (available as LICA 01 from Kenrich), neopentyl(diallyl)oxy tri(dodecyl)benzenesulfonyl titanate (available as LICA 09 from Kenrich), neopentyl(diallyl)oxy tri(dioctyl)phosphato titanate (available as LICA 12 from Kenrich), neopentyl(diallyl)oxy tri(dioctyl)pyro-phosphato titanate (available as LICA38 from Kenrich), neopentyl(diallyl)oxy tri(N-ethylenediamino)ethyl titanate (available as LICA 44 from Kenrich), neopentyl(diallyl)oxy tri(m-amino)phenyl titanate (available as LICA 97 from Kenrich), neopentyl(diallyl)oxy trihydroxy caproyl titanate (formerly available as LICA 99 from Kenrich and titanium (IV) butoxide (available from Sigma Aldrich).

[0088] Suitable zirconate coupling agents include, for example, those identified in U.S. Pat. No. 4,539,048 (Cohen). Specific examples include zirconium propionate, tetra(2,2-diallyloxymethyl)butyl di(ditridecyl)phosphito zirconate (available as KZ 55 from Kenrich), neopentyl(diallyl)oxy trineodecanoyl zirconate (available as NZ 01 from Kenrich), neopentyl(diallyl)oxy tri(dodecyl)benzenesulfonyl zirconate (available as NZ 09 from Kenrich), neopentyl(diallyl)oxy tri(dioctyl)phosphato zirconate (available as NZ 12 from Kenrich), neopentyl(diallyl)oxy tri(dioctyl)pyrophosphato zirconate (available as NZ 38 from Kenrich), neopentyl(diallyl)oxy tri(N-ethylenediamino)ethyl zirconate (available as NZ 44 from Kenrich), neopentyl(diallyl)oxy tri(m-amino)phenyl zirconate (available as NZ 97 from Kenrich), neopentyl(diallyl)oxy trimethacryl zirconate (available as NZ 33 from Kenrich), neopentyl(diallyl)oxy triacryl zirconate (formerly available as NZ 39 from Kenrich), dineopentyl(diallyl)oxy di(para-aminobenzoyl) zirconate (available as NZ 37 from Kenrich), and dineopentyl(diallyl)oxy di(3-mercaptopropionic) zirconate (available as NZ 66A from Kenrich).

[0089] Mixtures of one or more coupling agents may be used, although typically a single coupling agent is sufficient.

[0090] The amount of coupling agent used may be from about 0.1 wt. % to about 30 wt. %, from about 0.1 wt. % to about 25 wt. %, from about 0.1 wt. % to about 20 wt. %, from about 0.1 wt. % to about 15 wt. %, from about 0.1 wt. % to about 10 wt. % or even from about 0.1 wt. % to about 5 wt. % based on the weight of the silicone thermoplastic elastomer.

[0091] In some embodiments, one or both of the first and second primer layers that include a silicone thermoplastic elastomer may also include an optional tackifier resin. Preferred tackifier resins include silicone tackifier resins referred to as MQ resins, including but not limited to, silicone resin available

under the trade designation SILICONE MQ RESINS, from Siltech Corporation, Toronto, Canada and silicone resin available under the trade designation MQ-RESIN POWDER 803 TF, from Wacher Chemie, Munich, Germany. The amount of tackifier resin used may be from about 5 wt. % to about 75 wt%, or even 5 wt% to about 50 wt%, based on the weight of the silicone thermoplastic elastomer.

5 [0092] Commercially available primer layers may also be used, including, but not limited to, 3M ADHESION PROMOTER 111, available from 3M Company, St. Paul, Minnesota.

[0093] In some embodiments, the thickness of the first and second primer layers may be between about 50 nanometers (nm) and about 5 μm , between about 200 nm and about 5 μm , between about 400 nm and about 5 μm , between about 50 nm and about 3 μm , between about 200 nm and about 3 μm , between
10 about 400 nm and about 3 μm , between about 100 nm and about 1 μm , between about 200 nm and about 1 μm or even between about 400 nm and about 1 μm .

[0094] In some embodiments, the compressible multilayer article 200 may further include a first electrode 290, having a first major surface 291 and a second major surface 292. The first primer layer 270 is disposed between and in contact with at least a portion of the second major surface 242 of first tie-
15 layer 240 and first major surface 291 of first electrode 290. The compressible multilayer article 200 may further include a second electrode 295 having a first major surface 296 and a second major surface 297. The second primer layer 272 is disposed between and in contact with at least a portion of the second major surface 252 of the second adhesive tie layer 250 and the first major surface 296 of the second electrode 295.

20 [0095] In some example embodiments the first and second electrodes 290, 295 used in the compressible multilayer article 200 of FIG. 2 may be electrode constructions in a force-sensing capacitor element in an electronic display. In various embodiments, the electrodes in the electrode constructions may be metals, metal alloys, carbon based, or metal filled polymer, including but not limited to, indium-tin-oxide (ITO), antimony tin oxide (ATO), aluminum, copper, silver and gold, nickel, chrome, conductive polymer,
25 carbon, and graphene.

[0096] In some embodiments, the electrodes used with the compressible multilayer articles of the present disclosure may be electrically conductive composites containing one or more conductive particles, fibers, woven or non-woven mats and the like. The conductive particles, fibers, woven or non-woven mats may include the above metals. They also may be non-conductive particles, fibers, woven or non-woven mats
30 that have been coated with a conductive material, e.g. a metal, including but not limited to, aluminum, copper, silver and gold.

[0097] The electrodes used in the force-sensing capacitor elements may be thin films, e.g. a thin metal film or thin electrically conductive composite film. The thickness of the electrodes may be between about 0.1 μm and about 200 μm . The thickness may be greater than about 0.5 μm , greater than about 1 μm ,
35 greater than about 2 μm , greater than about 3 μm , greater than about 4 μm or even greater than about 5 μm ; less than about 50 μm , less than about 40 μm , less than about 30 μm , less than about 20 μm , or even less than 10 μm .

[0098] The electrodes may be fabricated by techniques used to form indium-tin-oxide traces in touch screen displays and techniques commonly used to form metal lines and vias in semiconductor manufacturing. Other useful techniques for fabricating the electrodes include screen printing, flexographic printing, inkjet printing, photolithography, etching, and lift-off processing.

[0099] The first and second electrodes 290, 295 may be multilayer electrodes that include two or more layers of conductive materials, as described above. The electrodes may also include one or more of the following: substrate layers, e.g. dielectric support substrate, insulating layers, adhesive layers, passivation layers, barrier layers, cover coats, protective coatings, and the like. These layers may be in any order.

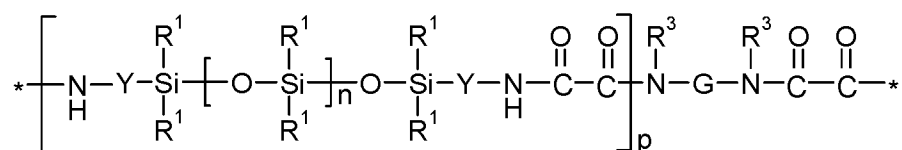
[0100] The electrodes may also include a passivation layer on at least a portion of their surface.

Passivation layers, e.g. a cover coat or layer, may be organic or inorganic materials that may be electrically insulating. Passivation layers include, but are not limited to, acrylics, polyurethanes, acylated polyurethanes, polyesters, copolyesters, polyimides, epoxies and acrylated epoxies. Combinations of these materials may be used. Adhesives may be used to bond the films to the electrically conductive substrate of the electrode, including, but not limited to, polyester adhesive, acrylic adhesive and epoxy adhesive. The electrode may also include a support substrate, e.g. a polymeric support substrate for example polyesters (PET), polyether ether ketone (PEEK), polyimide (PI), polyethylene naphthalate (PEN), polyetherimide (PEI), along with various fluoropolymers (FEP) and copolymers. In some embodiments, the first and/or second electrode may include at least one of a passivation layer and a dielectric support substrate.

[0101] The disclosure will now be illustrated by the following non-limiting example.

EXAMPLE

[0102] A silicone polyoxamide tie-layer coating solution was prepared by dissolving silicone polyoxamide pellets (25K silicone polyoxamide, available from 3M Company, St. Paul, Minnesota) at 10% w/w in ethyl acetate. Silicone Polyoxamides are described in U.S. Pat. No. 7,501,184 and are available upon request from 3M Company. The 25k silicone polyoxamide was described in this document per chemical formula I:



where R¹ is -CH₃, R³ is -H, G is -CH₂CH₂-, n is ~ 335, p = 1, and Y is -CH₂CH₂CH₂-.

[0103] A release liner was created by coating .002 inch (51 micron) PET film with Adhesion Promotor 111 (from 3M Co., St. Paul, MN) using a #22 Meyer rod. The coating was dried on a hot plate set at 80° C for 10 minutes.

[0104] The SPO_x was coated out of solvent and dried to a thickness of approximately 6 μm.

[0105] Shinetsu KE1950-30 two-part silicone was coated on the coated side of one piece of release liner at approximately 200 μm thick, and the second liner laminated to the silicone.

[0106] The assembly was cured at 260 °F (about 127 °C) for about 10 minutes.

5 [0107] A series of circular, post-like elastomeric structures was kiss cut into one side of the assembly using a laser, not cutting through one of the liners. The laser had a power of 1000 Watts and emitted light at a wavelength of 10.6 μm, was part of a web converting system available from Preco, Lanexa, KS, under the trade designation WebPro LB 3000.

10 [0108] A cap removal film included a 1 mil (0.025 mm) thick layer of a transfer adhesive on a liner, wherein the transfer adhesive was available from 3M, St. Paul, MN, under the trade designation Optically Clear Laminating Adhesive 8171. The cap removal film was laminated to the structured side of the assembly in a desktop laminator.

15 [0109] The cap removal film was peeled from the assembly, producing the post delivery film shown in FIG. 3 having an array of post-like elastomeric structures. A side view profile of a resulting post structure on the post delivery film is shown in FIG. 4.

[0110] The following are embodiments of the present disclosure:

20 [0111] Embodiment 1 is a method of making a compressible, multilayer article comprising: providing a multilayer elastomeric laminate film article comprising: a first adhesive tie layer on a first major surface of a first release liner; an elastomeric core layer comprising a cured silicone polymer onto a surface of the first adhesive tie layer; a second adhesive tie layer on a first major surface of the elastomeric core layer; and a second release liner on a major surface of the second adhesive tie layer; separating a selected portion of each of the second release liner, the second adhesive tie layer, the elastomeric core layer, and the first adhesive tie layer from the multilayer elastomeric laminate film article to form a patterned multilayer elastomeric film article comprising: an array comprising a plurality of discrete compressible structures attached to the first release liner, and an array comprising a plurality of chaff regions attached to the first release liner and interspersed between the discrete compressible structures.

25 [0112] Embodiment 2 is the method of embodiment 1, further comprising: laminating a cap removal film on the patterned multilayer elastomeric film article to form a delivery film article, wherein the cap removal film comprises an adhesive layer contacting the second release liner overlying the discrete compressible structures and the chaff regions; and removing the cap removal film from the delivery film article such that the second release liner overlying the chaff regions and overlying the discrete compressible structures adhere to the adhesive layer on the cap removal film such that: the array of discrete compressible structures remains attached to the first release liner, wherein each discrete compressible structure comprises an exposed adhesive bonding surface, and the chaff regions adhere to the adhesive layer on the cap removal film and separate from the first release liner.

30 [0113] Embodiment 3 is the method of embodiment 2, further comprising laminating the exposed adhesive bonding surface to a substrate.

[0114] Embodiment 4 is the method of embodiment 2, further comprising removing the first release liner from the array of discrete compressible structures to expose on each of the discrete compressible structures a second exposed adhesive bonding surface.

[0115] Embodiment 5 is the method of embodiment 3, further comprising applying a first primer layer to the first major surface of a first substrate; laminating the first primer layer to the first exposed adhesive bonding surface on a discrete compressible structure in the array; removing the second liner from the array; applying a second primer layer to the first major surface of a second electrode; and laminating the second primer layer to the second exposed adhesive bonding surface on a discrete compressible structure in the array.

[0116] Embodiment 6 is the method of embodiment 1, wherein the separating step comprises at least one of laser cutting or die cutting.

[0117] Embodiment 7 is the method of embodiment 1, wherein the chaff regions comprise the first adhesive tie layer, the second adhesive tie layer, the silicone elastomeric core layer between the first adhesive tie layer and the second adhesive tie layer, and the second release liner on the second adhesive tie layer.

[0118] Embodiment 8 is the method of embodiment 1, wherein the compressible structures comprise a first adhesive tie layer on the first release liner, a second adhesive tie layer, the silicone elastomeric core layer between the first adhesive tie layer and the second adhesive tie layer, and a second release liner on the second adhesive tie layer.

[0119] Embodiment 9 is the method of embodiment 1, wherein at least one of the first adhesive tie layer and the second adhesive tie layer comprise a silicone polyoxamide.

[0120] Embodiment 10 is the method of embodiment 1, wherein the silicone polymer comprises at least one of a silicone elastomer or a silicone thermoplastic elastomer.

[0121] Embodiment 11 is the method of embodiment 1, wherein the compressible structures on the first release liner comprise posts with a first end attached to the first release liner and a second end distal the first release liner, and wherein the posts have a height h between the first end the second end of about 1 μm and about 1000 μm , a width w_1 at the distal end of about 2 μm to about 6000 μm , and an aspect ratio, h/w_1 , between about 0.05 to about 5.

[0122] Embodiment 12 is the method of embodiment 11, wherein the aspect ratio of the posts is between about 0.2 to about 3.

[0123] Embodiment 13 is the method of embodiment 11, wherein the aspect ratio of the posts is between about 0.2 to about 1.

[0124] Embodiment 14 is the method of embodiment 11, wherein the compressible structures in the array are arranged in a repeating pattern.

[0125] Embodiment 15 is the method of embodiment 14, wherein the pattern comprises one of a square array or a hexagonal array.

[0126] Embodiment 16 is the method of embodiment 2, wherein the exposed adhesive bonding surface is substantially flat.

[0127] Embodiment 17 is the method of embodiment 1, wherein the first release liner and the release liner comprise PET films.

5 [0128] Embodiment 18 is a method of making a compressible, multilayer article comprising: cutting away a portion of a multilayer elastic laminate article to form a patterned multilayer elastomeric film article, wherein the multilayer elastic laminate film article comprises: a first release liner comprising a polymeric film, a first adhesive tie layer on the first release liner, wherein the first adhesive tie layer comprises a silicone polyoxamide, an elastomeric core layer on the first adhesive tie layer, wherein the
10 elastomeric core layer comprises a silicone polymer, a second adhesive tie layer on the elastomeric core layer, wherein the second adhesive tie layer comprises a silicone polyoxamide, and a release liner on the second adhesive tie layer, wherein the release liner comprises a polymeric film; and wherein the patterned multilayer elastomeric film article comprises: a first array comprising a plurality of discrete compressible structures attached to the first release liner, wherein the array is free of land areas between the discrete
15 structures, and a second array interspersed with the first array, wherein the second array comprises a plurality of chaff regions attached to the first release liner.

[0129] Embodiment 19 is the method of embodiment 18, further comprising: laminating a cap removal film on the patterned multilayer elastomeric film article to form a delivery film article, wherein the cap removal film comprises an adhesive layer contacting the release liner overlying the discrete compressible
20 structures and the chaff regions; and removing the cap removal film from the delivery film article such that the release liners overlying the chaff regions and overlying the discrete compressible structures adhere to the adhesive layer on the cap removal film such that: the array of discrete compressible structures remains attached to the first release liner, wherein each discrete compressible structure comprises an exposed adhesive bonding surface, and the chaff regions adhere to the adhesive layer on the
25 cap removal film and separate from the first release liner.

[0130] Embodiment 20 is a delivery film article, comprising: a first adhesive tie layer on a first release liner, wherein the first adhesive tie layer comprises a silicone polyoxamide; a second adhesive tie layer on a second release liner, wherein the second adhesive tie layer comprises a silicone polyoxamide; an elastomeric core layer between the first adhesive tie layer and the second adhesive tie layer, wherein the
30 elastomeric core layer comprises a silicone polymer; a first array comprising a plurality of discrete compressible structures attached to the first release liner, wherein the array is free of land areas between the discrete structures; and a second array interspersed with the first array, wherein the second array comprises a plurality of chaff regions attached to the first release liner, and a film comprising an adhesive layer contacting the second release liners attached to the discrete compressible structures and the chaff
35 regions.

[0131] Embodiment 21 is the delivery film article of embodiment 20, wherein the compressible structures on the first release liner comprise posts with a first end attached to the first release liner and a

second end distal the first release liner, and wherein the posts have a height h between the first end the second end of about 1 μm and about 1000 μm , a width w_1 at the second end of about 2 μm to about 6000 μm , a width w_2 at the first end of about 2 μm to about 6000 μm , and an aspect ratio, h/w_1 , between about <0.2 to about 5.

5 **[0132]** Embodiment 22 is the delivery film article of embodiment 21, wherein the aspect ratio of the posts is between about 0.2 to about 3.

[0133] Embodiment 23 is the delivery film article of embodiment 21, wherein the aspect ratio of the posts is between about 0.2 to about 1.

10 **[0134]** Embodiment 24 is the delivery film article of embodiment 21, wherein the compressible structures in the first array are arranged in a repeating pattern selected from square arrays, hexagonal arrays, and combinations thereof.

[0135] Embodiment 25 is a post delivery film article comprising an array of discrete compressible posts removably attached to a first release liner, the posts having no land areas therebetween, wherein the posts comprise: a first adhesive tie layer on the first release liner, wherein the first adhesive tie layer comprises
15 a silicone polyoxamide; an elastomeric core layer on the first adhesive tie layer, wherein the elastomeric core layer comprises a silicone polymer; a second adhesive tie layer on the elastomeric core layer, wherein the second adhesive tie layer comprises a silicone polyoxamide; and a second release liner on the second adhesive tie layer, wherein the posts have a first end attached to the first release liner and a second end distal the first release liner, wherein the posts have a height h between the first end the second end of
20 about 1 μm and about 1000 μm , a width w_1 at the second end of about 2 μm to about 6000 μm , a width w_2 at the first end of about 2 μm to about 6000 μm , and an aspect ratio, h/w_1 , between about 0.2 to about 5.

[0136] Embodiment 26 is the post delivery film article of embodiment 25, wherein the compressible structures in the first array are arranged in a repeating pattern selected from square arrays, hexagonal arrays, and combinations thereof.

25 **[0137]** Embodiment 27 is the post delivery film of embodiment 25, wherein the first release liner and the second release liner each comprise polymeric films.

[0138] Embodiment 28 is the post delivery film of embodiment 27, wherein the polymeric films comprise PET.

30 **[0139]** Embodiment 29 is the post delivery film of embodiment 25, wherein the second end distal the first release liner comprises a substantially flat adhesive bonding surface.

[0140] Embodiment 30 is a method of making a compressible, multilayer article comprising: coating a coating composition comprising a polysiloxane precursor resin onto a first layer of a polyoxamide adhesive on a first polymeric release liner film; laminating a second layer of a polyoxamide adhesive on the coating composition to form a laminate construction, wherein the second layer of the polyoxamide
35 adhesive is on a second polymeric release liner film; heating the laminate construction to cure the polysiloxane precursor resin to form an elastomeric core layer comprising a cured silicone polymer, and to bond the first layer of polyoxamide adhesive and the second layer of polyoxamide adhesive to the

elastomeric core layer; cutting away, with at least one of a laser or a die, a selected portion of each of the second polymeric release liner film, the second polyoxamide adhesive layer, the elastomeric core layer, and the first polyoxamide adhesive layer to form: a first array comprising a plurality of discrete compressible structures attached to the first polymeric release liner film, wherein the array is free of land areas between the discrete compressible structures, and an second array interspersed with the first array, wherein the second array comprises a plurality of chaff regions attached to the first polymeric release liner film; and laminating a tape over the first array and the second array, wherein the tape comprises an adhesive layer contacting the second polymeric release liner film overlying the discrete compressible structures and the chaff regions.

[0141] Embodiment 31 is a microstructured article, comprising: a flexible first substrate; and a plurality of discrete spaced apart individually removable posts disposed on a major surface of the first substrate, each discrete post comprising: a first tie layer removably attached to the major surface of the first substrate; an elastomeric layer disposed on the first adhesive layer; and a second tie layer disposed on the elastomeric layer; wherein each post is individually transferrable from the first substrate to a receiving substrate without removing any other post, the second tie layer facilitating permanent adhesion of the post to the receiving substrate.

[0142] Embodiment 32 is the microstructured article of embodiment 31, wherein each discrete post further comprises a flexible second substrate removably disposed on the second tie layer.

[0143] Embodiment 33 is the microstructured article of embodiment 31, wherein the major surface of the first substrate is exposed between the posts.

[0144] Embodiment 34 is the microstructured article of embodiment 1 further comprising a receiving substrate disposed on the plurality of posts, the second tie layers facilitating permanent adhesion of the post to the receiving substrate.

[0145] Various embodiments of the invention have been described. These and other embodiments are within the scope of the following claims.

CLAIMS:

1. A method of making a compressible, multilayer article comprising:

providing a multilayer elastomeric laminate film article comprising:

5 a first adhesive tie layer on a first major surface of a first release liner;

an elastomeric core layer comprising a cured silicone polymer onto a surface of the first adhesive tie layer;

a second adhesive tie layer on a first major surface of the elastomeric core layer; and

a second release liner on a major surface of the second adhesive tie layer;

10 separating a selected portion of each of the second release liner, the second adhesive tie layer, the elastomeric core layer, and the first adhesive tie layer from the multilayer elastomeric laminate film article to form a patterned multilayer elastomeric film article comprising:

an array comprising a plurality of discrete compressible structures attached to the first release liner, and

15 an array comprising a plurality of chaff regions attached to the first release liner and interspersed between the discrete compressible structures.

2. The method of claim 1, further comprising:

laminating a cap removal film on the patterned multilayer elastomeric film article to form a delivery film article, wherein the cap removal film comprises an adhesive layer contacting the second release liner overlying the discrete compressible structures and the chaff regions; and

20 removing the cap removal film from the delivery film article such that the second release liner overlying the chaff regions and overlying the discrete compressible structures adhere to the adhesive layer on the cap removal film such that:

25 the array of discrete compressible structures remains attached to the first release liner, wherein each discrete compressible structure comprises an exposed adhesive bonding surface, and

the chaff regions adhere to the adhesive layer on the cap removal film and separate from the first release liner.

3. The method of claim 1, wherein the compressible structures comprise a first adhesive tie layer on the first release liner, a second adhesive tie layer, the silicone elastomeric core layer between the first adhesive tie layer and the second adhesive tie layer, and a second release liner on the second adhesive tie layer.

4. The method of claim 1, wherein the compressible structures on the first release liner comprise posts with a first end attached to the first release liner and a second end distal the first release liner, and wherein the posts have a height h between the first end the second end of about 1 μm and about 1000 μm ,

a width w_1 at the distal end of about 2 μm to about 6000 μm , and an aspect ratio, h/w_1 , between about 0.05 to about 5.

5. A method of making a compressible, multilayer article comprising:

cutting away a portion of a multilayer elastic laminate article to form a patterned multilayer elastomeric film article, wherein the multilayer elastic laminate film article comprises:

a first release liner comprising a polymeric film,

a first adhesive tie layer on the first release liner, wherein the first adhesive tie layer comprises a silicone polyoxamide,

an elastomeric core layer on the first adhesive tie layer, wherein the elastomeric core layer comprises a silicone polymer,

a second adhesive tie layer on the elastomeric core layer, wherein the second adhesive tie layer comprises a silicone polyoxamide, and

a release liner on the second adhesive tie layer, wherein the release liner comprises a polymeric film; and

wherein the patterned multilayer elastomeric film article comprises:

a first array comprising a plurality of discrete compressible structures attached to the first release liner, wherein the array is free of land areas between the discrete structures, and

a second array interspersed with the first array, wherein the second array comprises a plurality of chaff regions attached to the first release liner.

6. A delivery film article, comprising:

a first adhesive tie layer on a first release liner, wherein the first adhesive tie layer comprises a silicone polyoxamide;

a second adhesive tie layer on a second release liner, wherein the second adhesive tie layer comprises a silicone polyoxamide;

an elastomeric core layer between the first adhesive tie layer and the second adhesive tie layer, wherein the elastomeric core layer comprises a silicone polymer;

a first array comprising a plurality of discrete compressible structures attached to the first release liner, wherein the array is free of land areas between the discrete structures; and

a second array interspersed with the first array, wherein the second array comprises a plurality of chaff regions attached to the first release liner, and

a film comprising an adhesive layer contacting the second release liners attached to the discrete compressible structures and the chaff regions.

7. The delivery film article of claim 6, wherein the compressible structures on the first release liner comprise posts with a first end attached to the first release liner and a second end distal the first release liner, and wherein the posts have a height h between the first end the second end of about 1 μm and about

1000 μm , a width w_1 at the second end of about 2 μm to about 6000 μm , a width w_2 at the first end of about 2 μm to about 6000 μm , and an aspect ratio, h/w_1 , between about $\ll 0.2$ to about 5.

8. A post delivery film article comprising an array of discrete compressible posts removably
5 attached to a first release liner, the posts having no land areas therebetween, wherein the posts comprise:
a first adhesive tie layer on the first release liner, wherein the first adhesive tie layer comprises a
silicone polyoxamide;

an elastomeric core layer on the first adhesive tie layer, wherein the elastomeric core layer
comprises a silicone polymer;

10 a second adhesive tie layer on the elastomeric core layer, wherein the second adhesive tie layer
comprises a silicone polyoxamide; and

a second release liner on the second adhesive tie layer,

wherein the posts have a first end attached to the first release liner and a second end distal the
first release liner, wherein the posts have a height h between the first end the second end of about 1 μm
15 and about 1000 μm , a width w_1 at the second end of about 2 μm to about 6000 μm , a width w_2 at the first
end of about 2 μm to about 6000 μm , and an aspect ratio, h/w_1 , between about 0.2 to about 5.

9. A method of making a compressible, multilayer article comprising:

coating a coating composition comprising a polysiloxane precursor resin onto a first layer of a
20 polyoxamide adhesive on a first polymeric release liner film;

laminating a second layer of a polyoxamide adhesive on the coating composition to form a
laminated construction, wherein the second layer of the polyoxamide adhesive is on a second polymeric
release liner film;

25 heating the laminated construction to cure the polysiloxane precursor resin to form an elastomeric
core layer comprising a cured silicone polymer, and to bond the first layer of polyoxamide adhesive and
the second layer of polyoxamide adhesive to the elastomeric core layer;

cutting away, with at least one of a laser or a die, a selected portion of each of the second
polymeric release liner film, the second polyoxamide adhesive layer, the elastomeric core layer, and the
first polyoxamide adhesive layer to form:

30 a first array comprising a plurality of discrete compressible structures attached to the first
polymeric release liner film, wherein the array is free of land areas between the discrete compressible
structures, and

an second array interspersed with the first array, wherein the second array comprises a plurality of
chaff regions attached to the first polymeric release liner film; and

35 laminating a tape over the first array and the second array, wherein the tape comprises an
adhesive layer contacting the second polymeric release liner film overlying the discrete compressible
structures and the chaff regions.

10. A microstructured article, comprising:
a flexible first substrate; and
a plurality of discrete spaced apart individually removable posts disposed on a major surface of
the first substrate, each discrete post comprising:
5 a first tie layer removably attached to the major surface of the first substrate;
an elastomeric layer disposed on the first adhesive layer; and
a second tie layer disposed on the elastomeric layer; wherein
each post is individually transferrable from the first substrate to a receiving substrate without removing
any other post, the second tie layer facilitating permanent adhesion of the post to the receiving substrate.

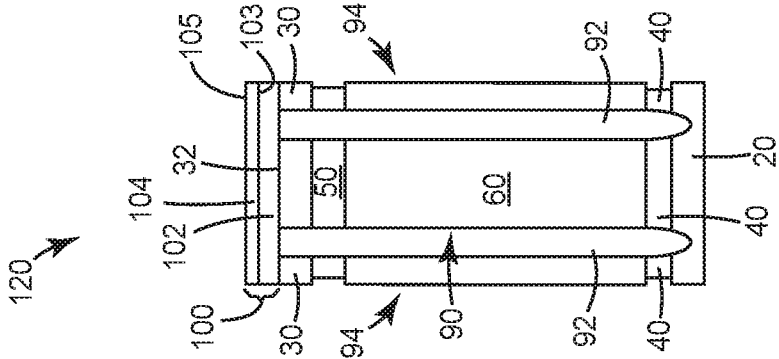
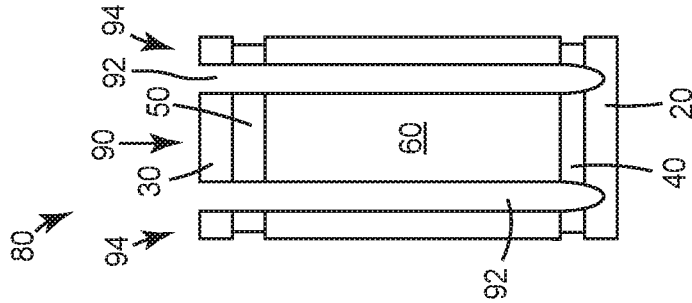
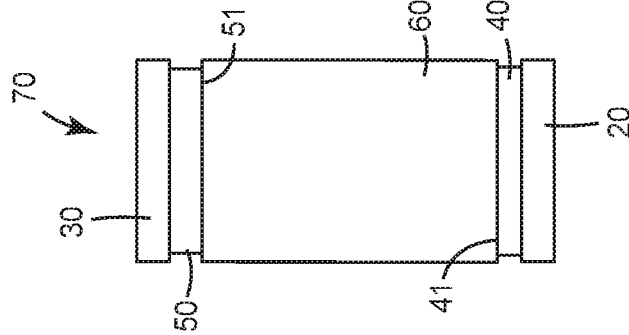
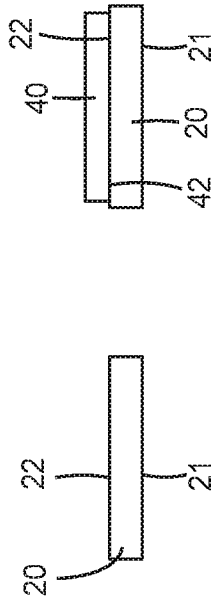
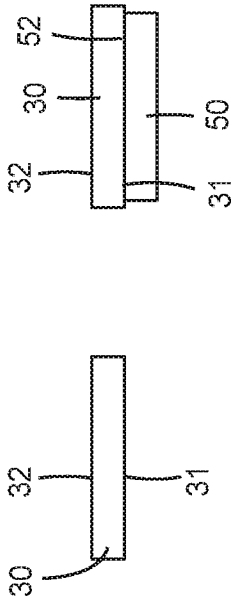
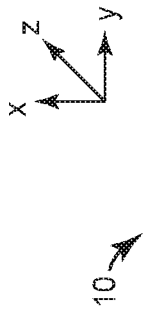


FIG. 1A

FIG. 1B

FIG. 1C

FIG. 1D

FIG. 1E

FIG. 1F

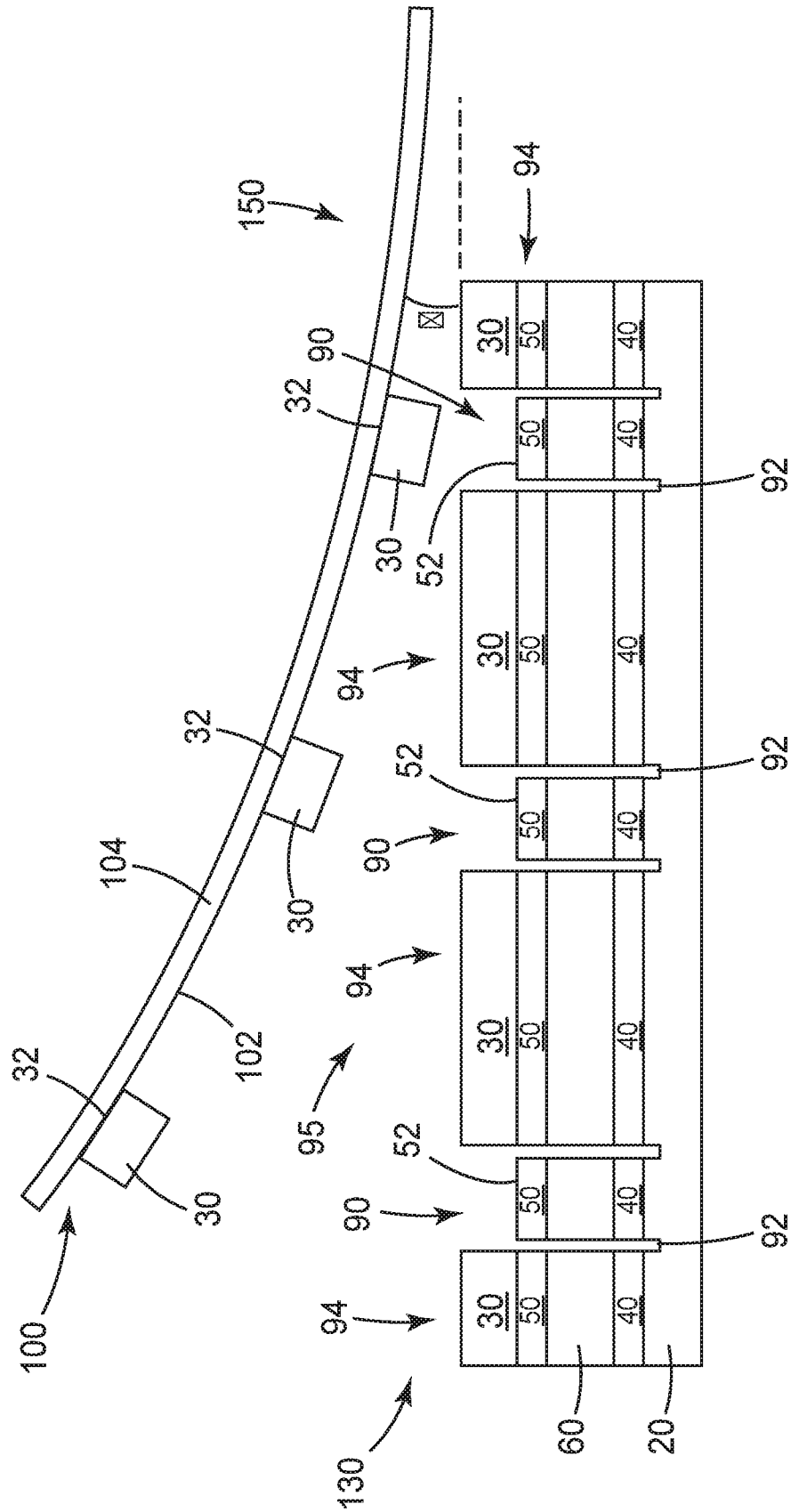
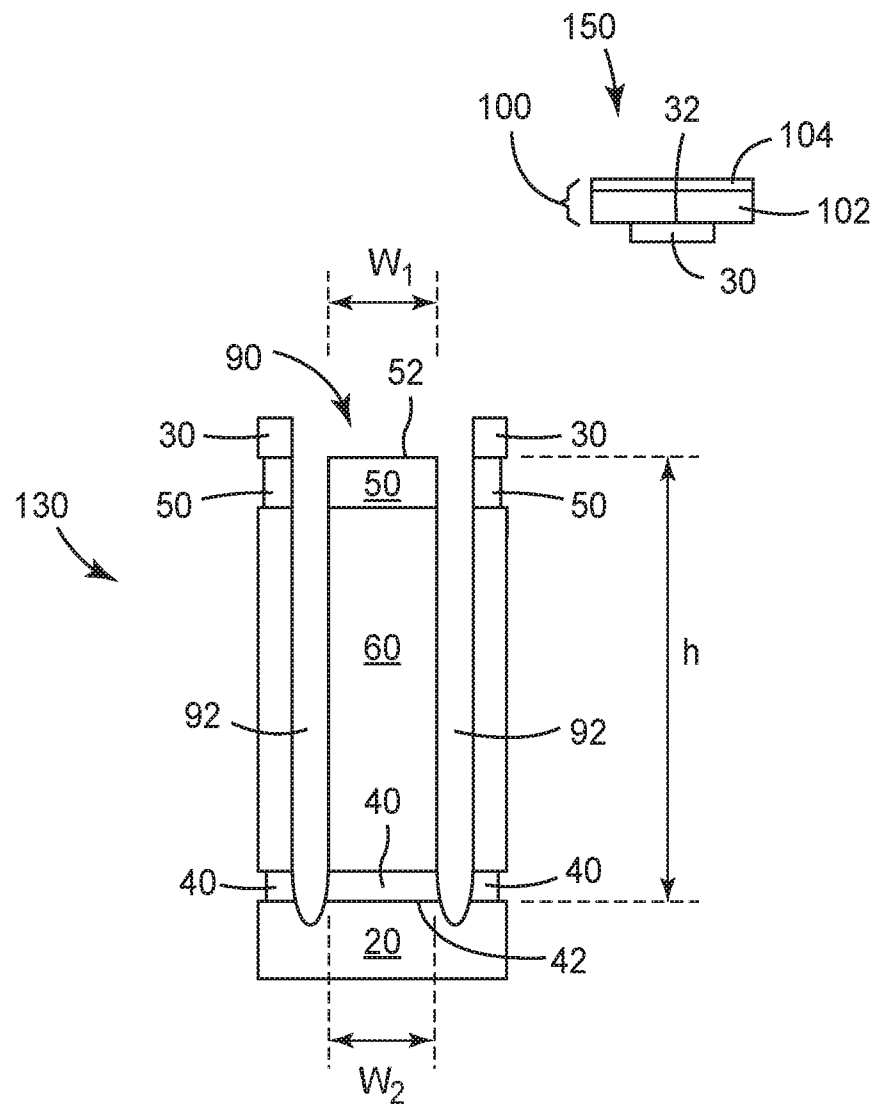


FIG. 1F-1

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*FIG. 1F-2*

97

<u>30</u>	<u>50</u>	<u>30</u>	<u>50</u>	<u>30</u>	<u>50</u>	<u>30</u>
<u>50</u>	<u>60</u>	<u>50</u>	<u>60</u>	<u>50</u>	<u>60</u>	<u>50</u>
<u>60</u>	<u>40</u>	<u>60</u>	<u>40</u>	<u>60</u>	<u>40</u>	<u>60</u>
<u>40</u>	<u>20</u>	<u>40</u>	<u>20</u>	<u>40</u>	<u>20</u>	<u>40</u>
<u>20</u>		<u>20</u>		<u>20</u>		<u>20</u>

FIG. 1F-3

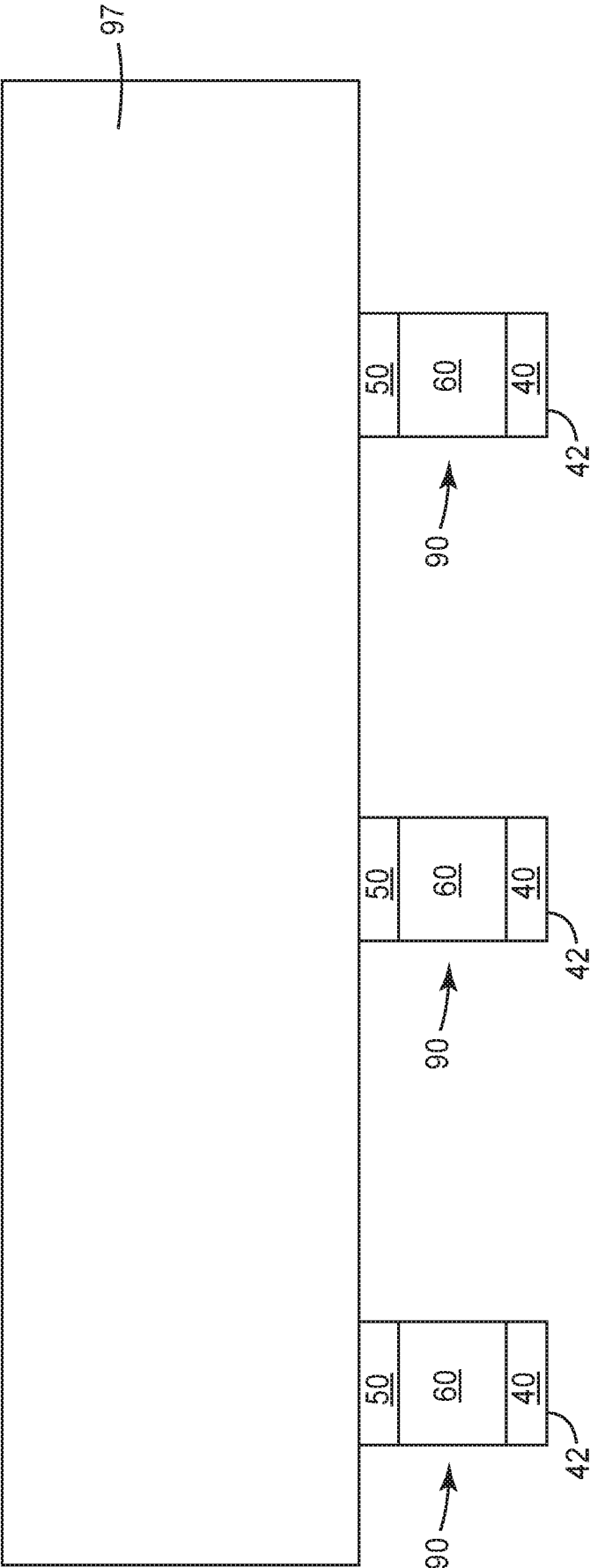


FIG. 1F-4

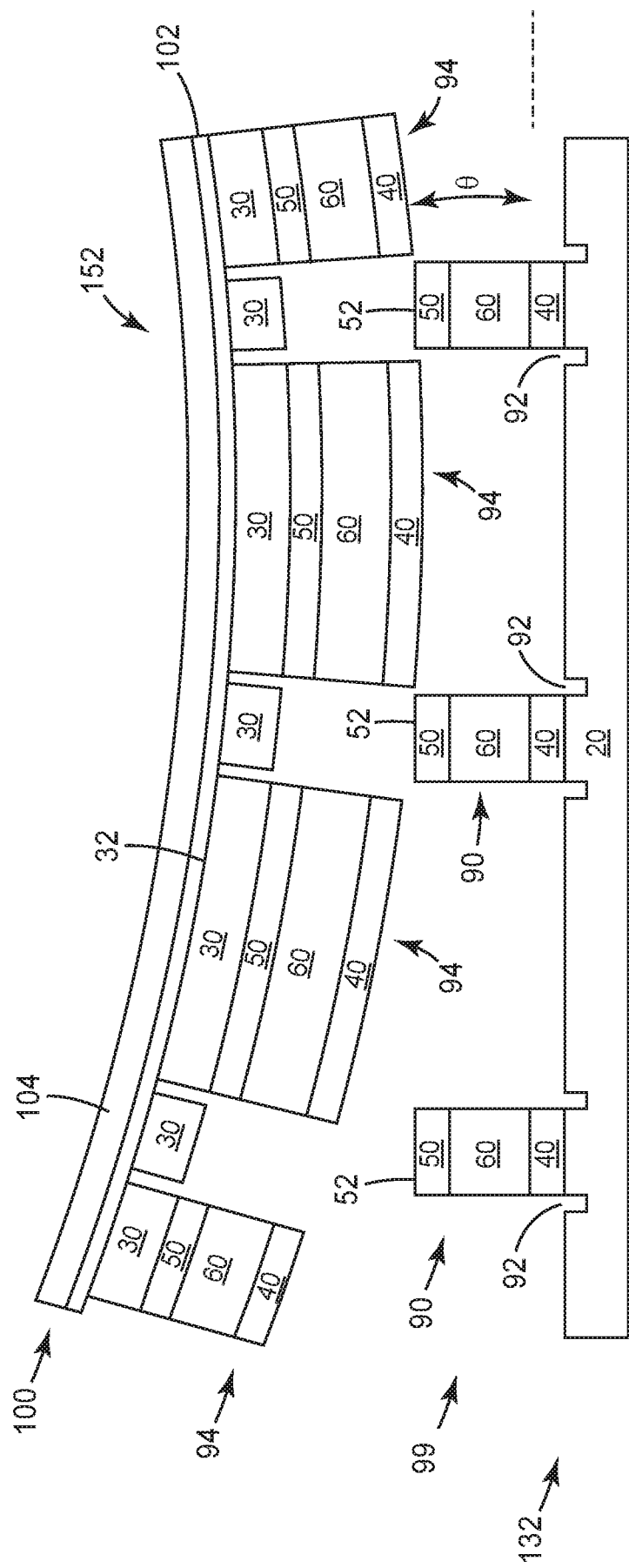


FIG. 1G-1

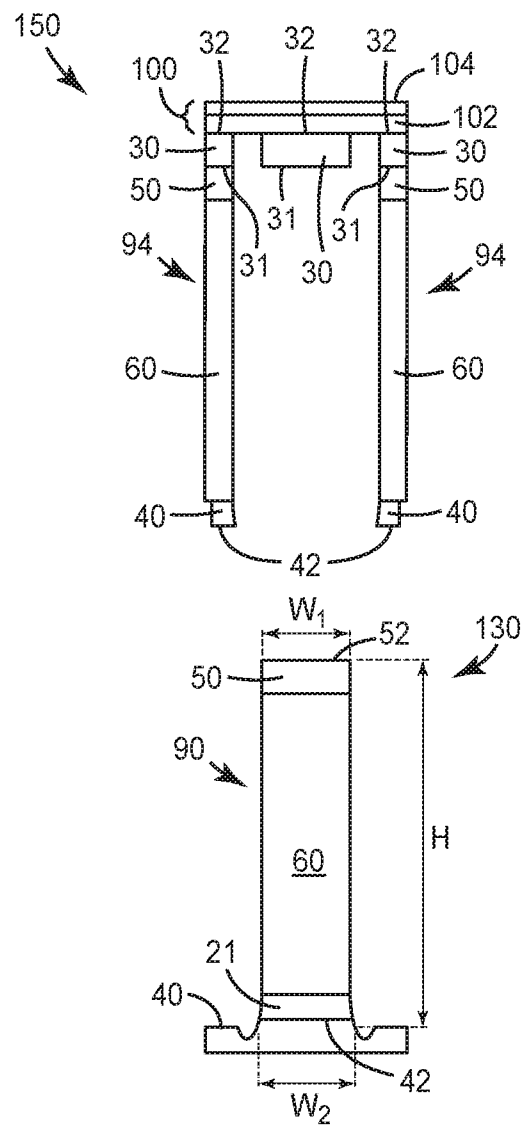


FIG. 1G-2

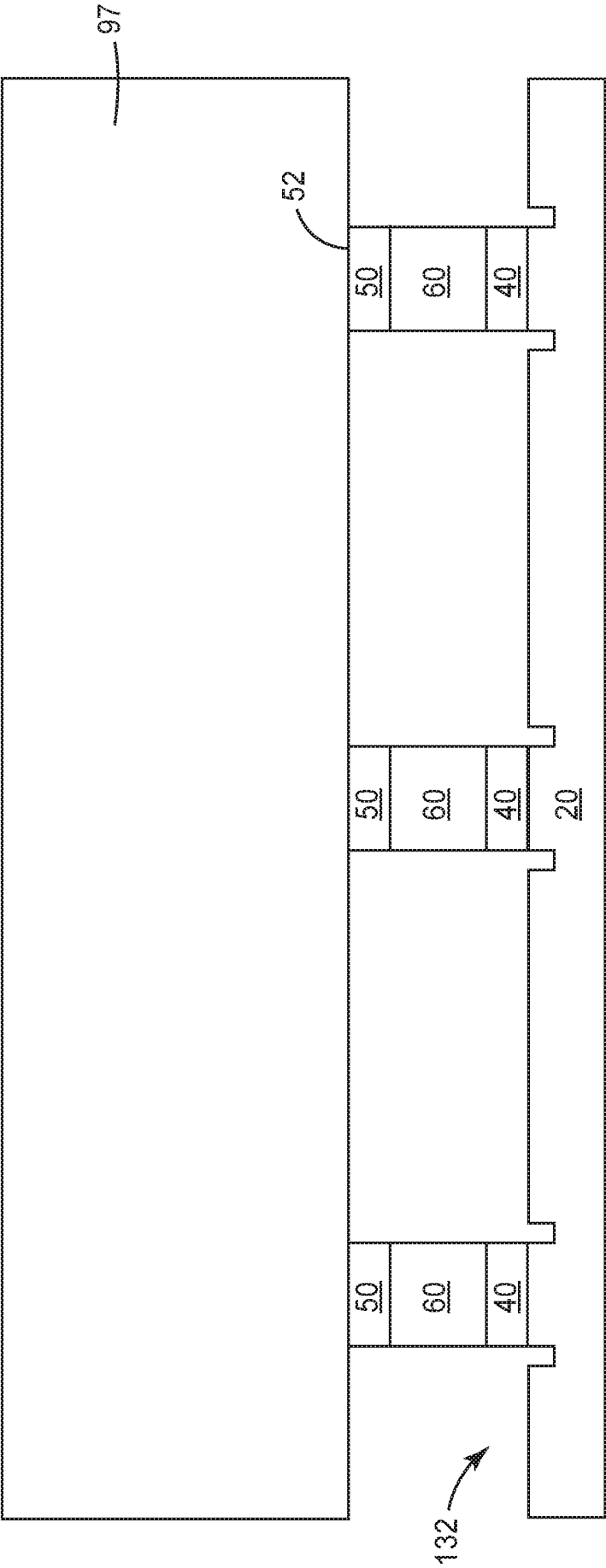


FIG. 1G-3

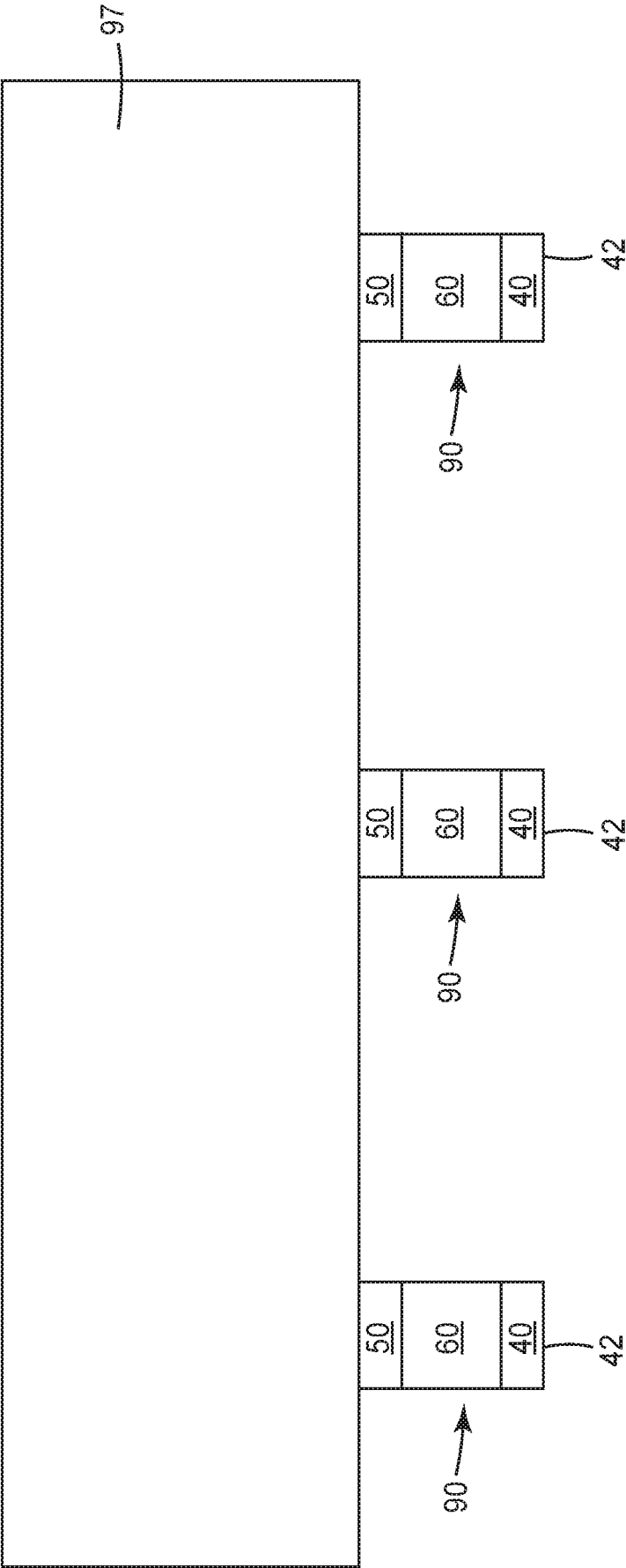
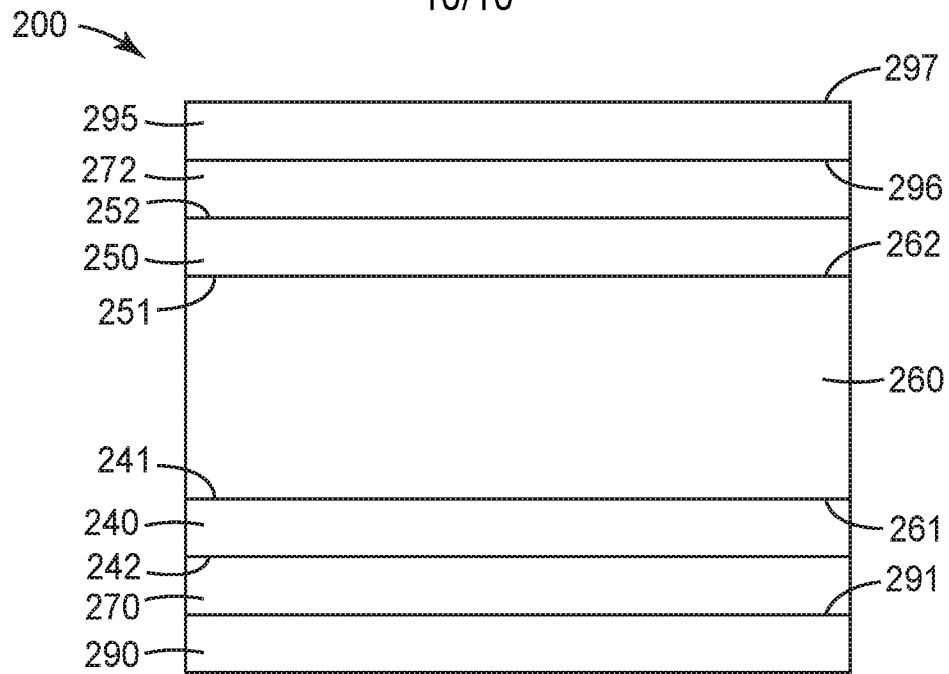
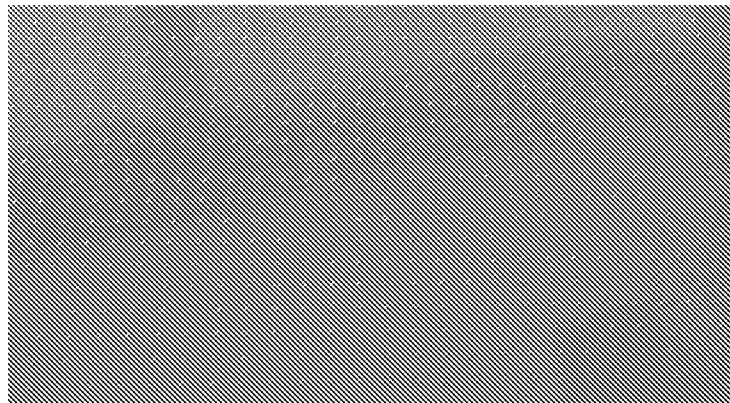
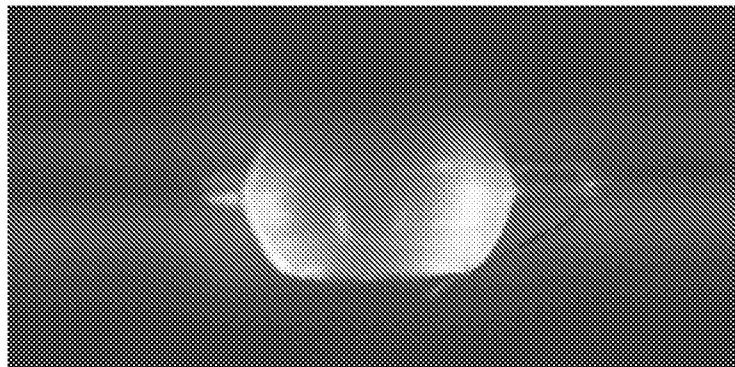


FIG. 1G-4

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*FIG. 2**FIG. 3**FIG. 4*

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/032781

A. CLASSIFICATION OF SUBJECT MATTER INV. B32B7/12 B32B7/14 B32B27/08 B32B27/28 B32B3/10 B32B3/26 B32B3/30 B32B7/04 B32B7/06 ADD. According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B32B G01L G06F B25J C09J Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 023 110 A1 (OMRON TATEISI ELECTRONICS CO [JP]; OMRON HEALTHCARE CO LTD [JP]) 11 February 2009 (2009-02-11) paragraphs [0037] - [0102]; figures 1-32 -----	1-10
X	DE 20 2016 101398 U1 (SCHILDERFABRIKATION MOEDEL GMBH [DE]) 2 May 2016 (2016-05-02) paragraphs [0015] - [0060]; figures 1-25 -----	1-10
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Date of the actual completion of the international search 31 July 2017		Date of mailing of the international search report 08/08/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Joly, Florence

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