connecting member 130 may be measured in an X-direction and the width may be measured in a Y-direction perpendicular to the X-direction. The connecting member 130 can have a first overall length and a first width in the first configuration and a second length and a second width in the second configuration. When the first assembly 110 and the second assembly 120 are closer to each other in the second configuration than in the first configuration, the second length may be smaller than the first length and the second width may be greater than the first width. When the first assembly 110 and the second assembly 120 are farther from each other in the second configuration than in the first configuration, the second length may be greater than the first length and the second width may be smaller than the first width.

[0030]

In some implementations, the connecting member 130 can have the same overall shape (e.g., a zig-zag shape or a sinusoidal shape) in the first configuration and the second configuration, and the shape can be compressed or expanded in the second configuration compared to the first configuration. For example, an angle between two segments coupled via an elastic hinge of the connecting member 130 can be a first angle in the first configuration and a second angle in the second configuration. When the first assembly 110 and the second assembly 120 are closer to each other in the second configuration than in the first configuration, the second angle may be smaller than the first angle. When the first assembly 110 and the second assembly 120 are farther from each other in the second configuration than in the first configuration, the second angle may be greater than the first angle.

[0031]

The connecting member 130 can have any suitable thickness along the length of the connecting member 130 and/or height relative to a bottom surface of the connecting member 130. In some implementations, the thickness of the connecting member 130 may vary along the length of the connecting member 130 (e.g., one or more portions of the connecting member 130 may be thicker compared to more narrow portions of the connecting member 130). The height of the connecting member 130 can be a distance extending in a Z-direction which is perpendicular to both the X and Y-directions. The thickness can be a distance disposed in a plane including the X and Y-directions (as describe in more detail below). In some embodiments, the thickness of the connecting member 130 and/or the height of the connecting member 130 can be sufficiently small such that the connecting member 130 is sufficiently elastic (e.g., has a sufficiently small spring constant) to expand and contract based on movement (e.g., deformation such as flexing) of the skin to prevent discomfort and/or detachment of the system 100 from the skin. For example, the thickness of the connecting member 130 and/or the height of the connecting member 130 can be sufficiently small such that the connecting member 130 has enough elasticity from a first end 136 of the connecting member 130 to a second end 138 of the connecting member 130 to expand and contract based on

can be shaped and sized such that the composite assembly 140 can be disposed between the cover layer and the bottom layer and the bottom layer can be disposed between the composite assembly 140 and the surface of the patient when the system 100 is coupled to the surface of the patient. The bottom surface can be coupled to the surface of the patient via the first adhesive portion 114, the second adhesive portion 124, and, optionally, the third adhesive portion 134. In some implementations, the bottom layer can define a first opening configured such that the first electrode 112 can contact the surface of the patient through the first opening and a second opening configured such that the second electrode 122 can contact the surface of the patient through the second opening. In some implementations, the cover layer may be monolithically or integrally formed. In some implementations, the bottom layer may be monolithically or integrally formed.

[0034]

In some implementations, the cover layer and the bottom layer can protect the system 100 from external effects (e.g., liquid (e.g., water or sweat) or mechanical impacts). In some implementations, the cover layer and the bottom layer can provide a sealed enclosure surrounding the composite assembly 140 such that the composite assembly 140 is protected from water during activities of the user such as, for example, showering or swimming. In some implementations, the bottom layer can include an adhesive on a side of the bottom layer facing the composite assembly 140 such that the bottom layer can be secured to the composite assembly 140. In some implementations, the system 100 can be waterproof and/or breathable for skin comfort. In some implementations, the system 100 can include hydrogel disposed on a skin-contacting side of the first electrode 112 and on a skin-contacting side of the second electrode 122. In some implementations, the hydrogel can include cut pads (e.g., cut from a hydrogel sheet). In some implementations, the hydrogel can be in the form of a dispensable gel. In some implementations, rather than including hydrogel, the first electrode 112 and the second electrode 122 can be dry electrodes configured to couple directly to a surface of the patient.

[0035]

The cover layer and the bottom layer can be formed of, for example, medical-grade materials (e.g., medical-grade materials manufactured by 3M and/or Adhesives Research). In some implementations, the cover layer and/or the bottom layer can be formed of a multi-layer material including adhesive layers. In some implementations, the adhesive includes synthetic rubber, acrylates, and/or silicones. In some implementations, the layers can include layers formed of polymers, PET, polyethylene (PE), polyurethane (PU), and/or polyamide (PA). The cover layer and the bottom layer can include film, non-woven materials, or a combination. In some implementations, the cover layer and/or the bottom layer can be formed of polyurethane materials combines with acrylic adhesives such that the cover layer and/or the bottom layer are waterproof,

apply strain along the length of the system 300, inducing stresses at the interface (e.g., an adhesive interface) of the first assembly 310 and/or the second assembly 320 with the surface S of the skin K.

[0045]

As shown in FIG. 3C, the first assembly 310 is coupled to the skin surface S at a first location and the second assembly 320 is coupled to the skin surface S at a second location. The skin K of the patient is under tension under a first force applied in the direction of arrow O and a second force opposite the first force applied in the direction of arrow P (i.e., opposing forces in the X-direction causing tensile skin strain). As a result of the tensile forces, the first location and the second location are pulled away from each other (i.e., the surface S is deformed via lateral expansion), causing the first end 336 and the second end 338 of the connecting member 330 to move away from each other. Because the connecting member 330 is not coupled to the surface S via adhesive and/or is not configured to be elastically deformed within a plane lying perpendicular to the surface S, the system 300 may induce a force M and a force N at the interface of the first assembly 310 and the second assembly 320, respectively, with the surface S of the skin K. The force M and the force N can disrupt the interface (e.g., disrupt adhesion via inducing a risk of adhesion loss) and can cause discomfort to the wearer of the system 300.

[0046]

In some implementations, an elastic connecting member and/or a third adhesive portion coupling the elastic coupling member to the surface of a patient's skin may improve conformality between the connecting member and the surface, for example, to avoid unwanted snags of the connecting member due to the gap G and/or to avoid forces applied by the connecting member on the first or second assembly that may cause the first or second assembly to loosen from the surface. FIGS. 4A and 4B are schematic illustrations of a side view of a system 400 coupled to a surface S of a skin K of a patient in a first configuration and a second configuration, respectively. The system 400 can be similar in structure and/or function to any of the systems described herein. For example, the system 400 can include a first assembly 410, a second assembly 420, and a connecting member 430. The connecting member 430 has a first end 436 coupled to the first assembly 410 and a second end 438 coupled to the second assembly 420. As shown in FIGS. 4A and 4B, the system 400 can be able to deform with the surface S of the skin K and remain conformal with the surface S of the skin K. Furthermore, although not shown, the connecting member 430 can be coupled to the surface S via a third adhesive portion to improve conformality during deformation of the surface S.

[0047]

As shown in FIG. 4A, the first assembly 410 is coupled to the surface S at a first location and the second assembly 420 is coupled to the surface S at a second location. The skin K of the patient is under compression under a first force applied in the

direction of arrow C and a second force opposite the first force applied in the direction of arrow D (i.e., opposing forces in the X-direction). As a result of the compressive forces, the first location and the second location have been pushed closer to each other, causing the first end 436 and the second end 438 of the connecting member 430 to move closer to each other. Since the connecting member 430 is coupled to the surface S via adhesive and is configured to be elastically deformed within a plane lying perpendicular to the surface S, the connecting member 430 can remain conformed to the surface S such that no gap is defined between the connecting member 430 and the surface S. Thus, the system 400 can accommodate compressive deformation such that the connecting member 430 remains conformal to the surface S of the skin K with reduced stress on the adhesive interfaces between each of the first assembly 410, the second assembly 420, and the connecting member 430 with the surface S compared to a system with a non-deformable coupling member.

[0048]

As shown in FIG. 4B, the first assembly 410 is coupled to the skin S at a first location and the second assembly 420 is coupled to the skin S at a second location. The skin K of the patient is under tension under a first force applied in the direction of arrow E (i.e., in the Z-direction away from the system 400). As a result of the first force, the first location and the second location have been pushed closer to each other. Since the connecting member 430 is coupled to the surface S via adhesive, the connecting member 430 remains conformed to the surface S such that no gap is defined between the connecting member 430 and the surface S.

[0049]

As described above with respect to third adhesive portion 134, a connecting member can be coupled to a surface of a patient via one or more adhesive portions. FIGS. 5A-5C show variations of a system with examples of adhesive portions in various locations. FIG. 5A is a schematic illustration of a bottom view of a system 500. The system 500 can be the same or similar in structure and/or function to any of the systems described herein, such as the system 100 described with respect to FIG. 1. For example, the system 500 includes a first assembly 510, a second assembly 520, and a connecting member 530, which can be the same or similar in structure and/or function to the first assembly 110, the second assembly 120, and the connecting member 130, respectively. The connecting member 530 has a first end 536 coupled to the first assembly 510 and a second end 538 coupled to the second assembly 520. The connecting member 530 can be shaped as one period of a sinusoidal wave. For example, the connecting member 530 includes a first segment 537A, a second segment 537B, and a third segment 537C. The connecting member 530 also includes a first elastic hinge 539A and a second elastic hinge 539B. The first segment 537A is coupled to the second segment 537B via the first elastic hinge 539A. The second segment 537B is coupled to the third segment 537C via the second elastic hinge 539B. The first

Claims

[Claim 1]

A system, comprising:

a first assembly including a first electrode and a first adhesive portion, the first assembly configured to be coupled to a surface of a patient via the first adhesive portion;

a second assembly including a second electrode and a second adhesive portion, the second assembly configured to be coupled to the surface of the patient via the second adhesive portion; and

a connecting member having a first end, a second end, and a third adhesive portion, the first end coupled to the first assembly and the second end coupled to the second assembly, the connecting member configured to transition between a first configuration and a second configuration, a distance between the first end and the second end of the connecting member in the first configuration being a first distance, a distance between the first end and the second end of the connecting member in the second configuration being a second distance different from the first distance, the connecting member configured to be coupled to the surface of the patient via the third adhesive portion in both the first configuration and the second configuration,

wherein the connecting member has a composite assembly portion, the composite assembly portion having an insulative portion and a plurality of conductive traces disposed within the insulative portion and electrically coupling the first and second assemblies,

wherein the plurality of conductive traces has a first conductive trace and a second conductive trace,

wherein the first conductive trace and the second conductive trace are disposed at varying locations relative to a skin-facing surface of the composite assembly portion such that the first conductive trace is disposed further from the skin-facing surface than the second conductive trace.

[Claim 2]

The system of claim 1, wherein the first conductive trace is vertically arranged relative to the second conductive trace such that the composite assembly portion can be narrower.

[Claim 3]

The system of claim 1, wherein the plurality of conductive traces has a third conductive trace electrically coupling the first and second assemblies, the third conductive trace being disposed close to the skin-facing surface and side-by-side with the second conductive trace.

[Claim 4]

The system of claim 3, wherein the first conductive trace is vertically arranged relative to the second and third conductive traces such that the portion can be narrower.

[Claim 5]

The system of claim 1, wherein the plurality of conductive traces has a third conductive trace and a fourth conductive trace electrically coupling the first and second assemblies, the fourth conductive trace being disposed close to the skin-facing surface and side by side with the second conductive trace while the third conductive trace being disposed further from the skin-facing surface and side by side with the first conductive trace.

[Claim 6]

The system of claim 5, wherein the first and third conductive traces are vertically arranged relative to the second and fourth conductive traces such that the portion can be narrower.

[Claim 7]

The system in any one of claims 1-6, wherein the connecting member is configured to transition from the first configuration to the second configuration based at

least in part on movement of the first assembly relative to the second assembly due to deformation of the surface of the patient.

[Claim 8]

The system in any one of claims 1-6, wherein the connecting member is biased toward the first configuration.

[Claim 9]

The system in any one of claims 1-6, wherein the connecting member is configured to be coupled to the surface of the patient via the third adhesive portion during the transition from the first configuration to the second configuration.

[Claim 10]

The system in any one of claims 1-6, wherein the connecting member includes the skin-facing surface, the third adhesive portion configured to cover a portion of the skin-facing surface.

[Claim 11]

The system in any one of claims 1-6, wherein the connecting member further includes a fourth adhesive portion, the third adhesive portion disposed on the skin-facing surface of the connecting member at a first location, the fourth adhesive portion disposed on the skin-facing surface of the connecting member at a second location.

[Claim 12]

The system in any one of claims 1-6, wherein the connecting member includes a first segment, a second segment, and a third segment, the first segment coupled to the second segment via a first flexible hinge, the second segment coupled to the third segment via a second flexible hinge.

[Claim 13]

The system in any one of claims 1-6, wherein the connecting member has a first sinusoidal shape in the first configuration and a second sinusoidal shape in the second configuration, the second sinusoidal shape in the second configuration being compressed or expanded compared to the first sinusoidal shape in the first configuration.