ELECTROACTIVE POLYMER STRUCTURE

BACKGROUND

The patent application is generally in the field of electroactive polymer (EAP) structures.

Typical EAP structures include EAP attached to fixed frames, which result in bulky, heavy structures. Typical EAP structures also include EAP bladders, which have poor local control over shape.

A need exists for EAP structures having decreased bulk and mass. In addition, a need exists for EAP structures having increased flexibility and local control over shape.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top view of one embodiment of an EAP structure.

FIG. **2**A is a top view of one embodiment of an EAP structure.

FIG. **2**B is a top view of one embodiment of an EAP structure.

FIG. **3** is a perspective view of one embodiment of an EAP structure.

FIG. **4**A is a side view of one embodiment of an EAP structure.

FIG. **4**B is a side view of one embodiment of an EAP structure.

FIG. **4**C is a side view of one embodiment of an EAP structure.

FIG. **4**D is a side view of one embodiment of an EAP structure.

FIG. **5** is a flowchart of an exemplary method of one embodiment of an EAP structure.

DETAILED DESCRIPTION

Electroactive Polymer Structures are described herein.

Glossary

The following definitions and acronyms are used herein:

Acronym(s):

EAP—Electroactive Polymer

Definition(s):

Activator—facilitate activation of electroactive polymers

Braid Angle—angle that forms between two overlapping strands of a braided structure

The EAP structure includes a concatenated plurality of EAP segments that form an EAP strand, wherein each EAP segment is electrically isolated from other EAP segments and can be individually controlled. In one embodiment, the EAP structure includes a plurality of strands that are braided to form an EAP braided structure, which can selectively deform by activating individual EAP segments or specified groups of EAP segments. In one embodiment, the EAP structure comprises a biaxial braid. Examples of EAP structures include a snake, a ball, a plate and an animal-shaped toy. In one embodiment, the EAP structure has decreased bulk and mass. In one embodiment, the EAP structure has increased flexibility. In one embodiment, the EAP structure has increased local control over shape. By assembling EAP strands into braided structures, EAP segments of EAP strands can cooperate to move the braided structure, both locally and globally, and apply directed forces upon the internal or external environments. A braided structure can distribute forces across both surfaces of overlapping EAP segments. In addition, a braided structure permits EAP segments to shift spatial relationships to achieve deformations of the global braided structure, and then to renormalize spatial relationships when forces are removed.

FIG. **1** is a top view of one embodiment of an EAP structure. FIG. **1** shows an EAP strand embodiment. The EAP strand includes a concatenated plurality of EAP segments that are separated by insulators. As shown in FIG. **1**, EAP strand **110** includes EAP segments **108**, **148**, **168** and insulators **192**, **194**, **196**, **198**. Insulators **192**, **194**, **196**, **198** comprise nonconductive material such as plastic. Insulator **194** electrically isolates EAP tile **112** and EAP tile **114**; and insulator **196** electrically isolates EAP tile **114** and EAP tile **116**.

EAP segments include EAP tiles and activators (e.g., first electrodes and second electrodes). Activators facilitate activation of EAP tiles. EAP segment **108** includes EAP tile **112**, first electrode **104** and second electrode **106**; EAP segment **148** includes EAP tile **114**, first electrode **144** and second electrode **146**; and EAP segment **168** includes EAP tile **116**, first electrode **164** and second electrode **166**. EAP tile **112** has width **120** and length **130**. Width **120** and length **130** are substantially greater than the depth of EAP tile **112**. EAP tile **112** comprises electroactive polymer material. In one embodiment, EAP tile **112** comprises conductive polymers. Exemplary conductive polymers include polypyrroles, polyanilines, polyacetylenes, polyethyldioxithiophenes, and polythiophenes. In one embodiment, EAP tile **112** comprises dielectric elastomers. Exemplary dielectric elastomers include Dow Corning HS3 silicone, Nusil CF 19-2186 silicone, and 3M VHB 4910 acrylic. Those skilled in the art shall recognize that actuators other than EAP such as, for example, ferroelectric polymers, liquid crystal elastomers, carbon nanotube actuators, ionic polymer metal composites, can be used with the EAP structure without departing from the scope or spirit of the EAP structure.

First electrodes **104**, **144**, **164** and second electrodes **106**, **146**, **166** comprise conductive material such as, for example, metal, semiconductor, conductive fluid, conductive polymer, photonic charge release material and a combination thereof. First electrodes **104**, **144**, **164** and second electrodes **106**, **146**, **166** can be used to activate EAP tiles **112**, **114**, **116**. Specifically, first electrode **104** and second electrode **106** can be used to activate EAP tile **112**; first electrode **144** and second electrode **146** can be used to activate EAP tile **114**; and first electrode **164** and second electrode **166** can be used to activate EAP tile **116**. In one embodiment, EAP tile **112** deforms when first electrode **104** and second electrode **106** have different voltage potentials. In one embodiment, phase and potential can be changed to obtain a great diversity of motion. A controller (not shown in FIG. **1**) can be operatively coupled to first electrodes **104**, **144**, **164** and second electrodes **106**, **146**, **166** to individually control voltage potentials between these electrodes. Thus, EAP tiles **112**, **114**, **116** can be activated individually or in groups because first electrodes **104**, **144**, **164** and second electrodes **106**, **146**, **166** can be controlled individually. In one embodiment, EAP strand **110** is encased in a conductive polymer.

A plurality of EAP strands can be configured into an EAP structure. Those skilled in the art shall recognize that an EAP structure can comprise numerous configurations without departing from the scope or spirit of the EAP structure. Exemplary EAP structures include EAP biaxial braids, EAP biaxial braided snakes, EAP braided spheres, EAP braided