CLAIMS

1. A method of producing an electromechanical polymer multilayer structure, the method comprising:

a) depositing a first suspension of electromechanical polymer powder particles on a conductive surface of a substrate connected to a power supply to form a first polymer layer;

b) depositing a first electrode layer on the first polymer layer;

c) connecting the first electrode layer to the power supply and depositing a second suspension of electromechanical polymer powder particles on the first electrode layer to form a second polymer layer;

d) depositing a second electrode layer on the second polymer layer;

e) connecting the second electrode layer to the power supply and depositing a third suspension of electromechanical polymer powder particles on the second electrode layer to form a third polymer layer;

f) repeating steps (b)-(e) to form an electromechanical polymer multilayer structure comprising a plurality of polymer layers, a plurality of first electrode layers and a plurality of second electrode layers, wherein each of the polymer layers is disposed between two adjacent electrode layers; and

wherein the plurality of first electrode layers are interconnected to form a first electrode group of a first type and the plurality of second electrode layers are interconnected to form a second electrode group of a second type; and

wherein the first electrode layers of the first electrode group are electrically insulated from the second electrode layers of the second electrode group.

2. The method according to claim 1, wherein the electromechanical polymer powder particles are deposited on the conductive surface of the substrate by electrophoretic deposition, the electrophoretic deposition comprising:

immersing the conductive surface of the substrate into the first suspension of electromechanical polymer powder particles; and

applying an electrical potential across the conductive surface of the substrate and a counter electrode.

3. The method according to claim 1, wherein the electromechanical polymer powder particles are deposited on the first electrode layer and the second electrode layer by electrophoretic deposition, the electrophoretic deposition comprising:

immersing the first electrode layer and the second electrode layer into the second suspension of electromechanical polymer powder particles and the third suspension of electromechanical polymer powder particles, respectively; and

applying an electrical potential across each of the first electrode layer and the second electrode layer, respectively, and a counter electrode.

4. The method according to claim 3, wherein a portion of the first electrode layer and a portion of the second electrode layer are each not immersed in the suspension of electromechanical polymer powder particles during the electrophoretic deposition and the portions are exposed for realizing the electrical connection.

5. The method according to claim 1, further comprising:

treating the electromechanical polymer powder particles deposited on the substrate, on the first electrode layer and on the second electrode layer with heat above melting temperature of the electromechanical polymer powder particles to form continuous polymer layers.

6. The method according to claim 1, wherein the electromechanical polymer powder particles are selected from a group of piezoelectric polymers, including poly(vinylidene fluoride) (PVDF) and poly(vinylidene fluoride and trifluoroethylene) P(VDF/TrFE).

7. The method according to claim 1, wherein all the first, the second and the third suspensions of electromechanical polymer powder particles are prepared by dispersing the electromechanical polymer powder particles in isopropyl alcohol to form a stable suspension.

8. The method according to claim 1, wherein the first electrode layer and the second electrode layer are each deposited on the first polymer layer and the second polymer layer, respectively, by physical vapour deposition of a conductive layer on the first polymer layer and the second polymer layer.

9. The method according to claim 1, further comprising:

patterning the plurality of first electrode layers and the plurality of second electrode layers to form an array of a plurality of electromechanical elements.

10. The method according to claim 1, wherein the substrate is a curved substrate with a focal point.

11. The method according to claim 1, further comprising:

removing the substrate by chemical etching after the electromechanical polymer multilayer structure is formed.

12. The method according to claim 1, wherein the electromechanical polymer multilayer structure having a thickness ranging from 1 to 100 μm.

13. An electromechanical polymer multilayer structure comprising:

at least one unit of successive layers, each unit comprises:

a first polymer layer;

a first electrode layer deposited on the first polymer layer;

a second polymer layer deposited on the first electrode layer; and

a second electrode layer deposited on the second polymer layer;

wherein each of the polymer layers is formed from a suspension of electromechanical polymer powder particles through connecting each of the electrode layers to a power supply to allow deposition of the polymer powder particles on each of the electrode layers, and each of the polymer layers is disposed between two adjacent electrode layers;

wherein the first electrode layers of the successive layers are interconnected to form a first electrode group of a first type and the second electrode layers of the successive layers are interconnected to form a second electrode group of a second type; and

wherein the first electrode layers of the first electrode group are electrically insulated from the second electrode layers for the second electrode group.

14. The electromechanical polymer multilayer structure according to claim 13, wherein the first electrode layers are interconnected at a portion not exposed to the electromechanical polymer powder particles to form the first electrode group of the first

type; and the second electrode layers are interconnected at another portion not exposed to the electromechanical polymer powder particles to form the second electrode group of the second type.

15. The electromechanical polymer multilayer structure according to claim 13, wherein the first electrode layers and the second electrode layers are patterned to form an array of a plurality of electromechanical elements.

16. The electromechanical polymer multilayer structure according to claim 13, wherein the electromechanical polymer multilayer structure is curved with a radius of curvature.

17. An electromechanical device comprising an electromechanical polymer multilayer structure as described in claims 13-16.

18. An electromechanical device according to claim 17, wherein the electromechanical polymer multilayer structure is configured to convert acoustic wave into electrical signal for acoustic wave sensing, and/or convert applied voltage into acoustic wave for acoustic wave generation.

19. The electromechanical device according to claim 17, for use as a focused acoustic transducer with focal length equal to the radius of curvature of the multilayer structure.

20. The electromechanical device according to claim 17, for use as acoustic transducer to sense acoustic waves generated by light for photoacoustic sensing and imaging.