CLAIMS

What is claimed is:

1. An energy storage device comprising

a first electrode,

a second electrode, and

a solid multilayer structure disposed between said first and second electrodes,

wherein said electrodes are flat and planar and positioned parallel to each other, and

wherein said solid multilayer structure comprises ***m*** insulating and conductive layers,

said layers are disposed parallel to said electrodes, and

said layers have the following sequence: A-B-(A-B-…A-B-)A, where

A is a homogeneous insulating layer which comprises an insulating dielectric material,

B is a homogeneous conductive layer, and

m is equal to 3 or more.

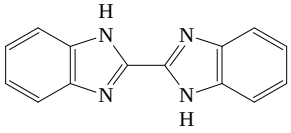
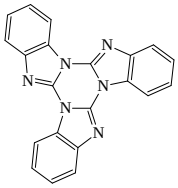
2. An energy storage device according to Claim 1, wherein said insulating layers are crystalline.

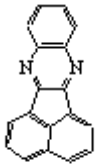
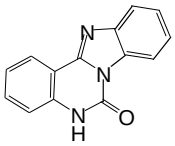
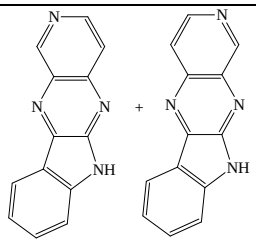
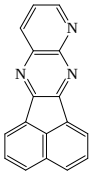
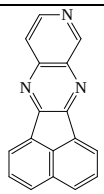
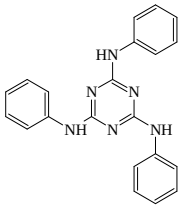
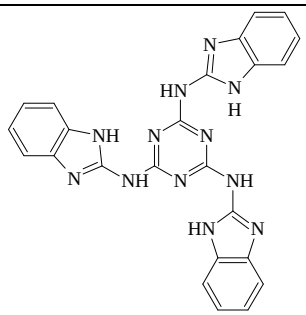
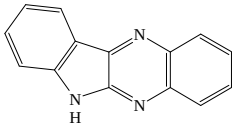
3. An energy storage device according to Claim 1, wherein said insulating layers comprise modified organic compounds of the general structural formula I:

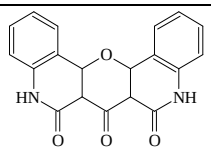
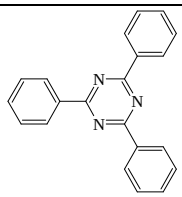
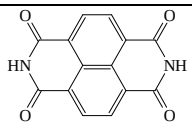
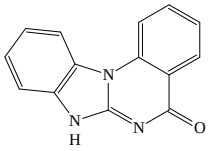
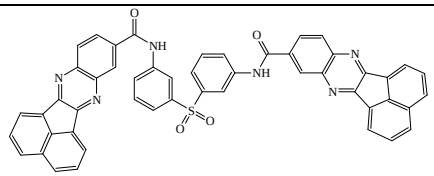
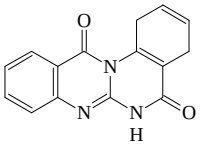
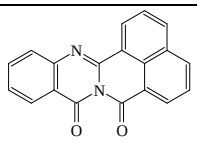
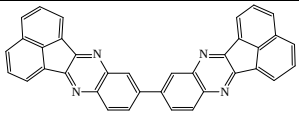
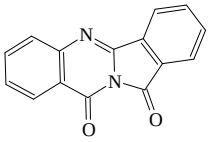
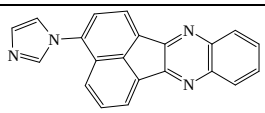
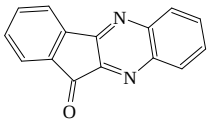
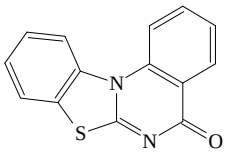
{Cor}(M)n, (I)

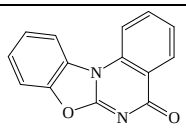
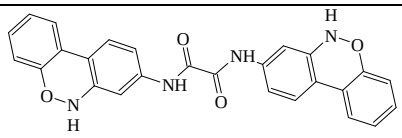
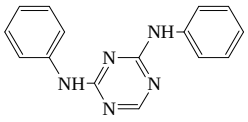
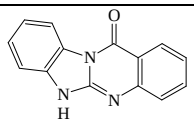
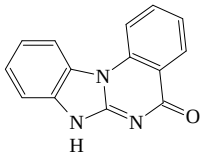
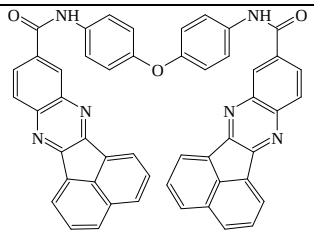
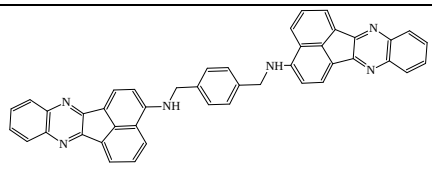
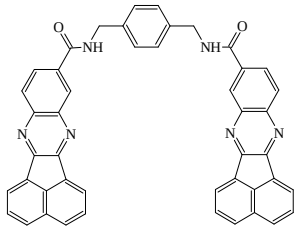
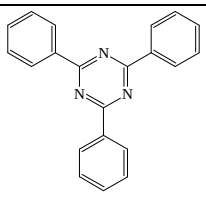
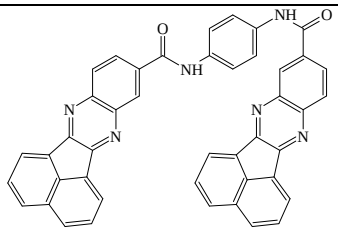
where Cor is a polycyclic organic compound with conjugated π-system, M are modifying functional groups; and *n* is the number of the modifying functional groups, where *n* is equal to 1 or more.

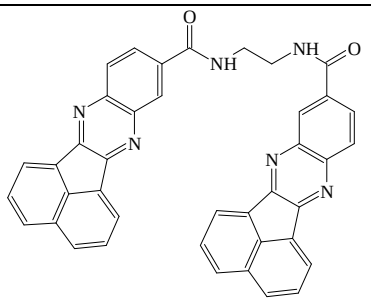
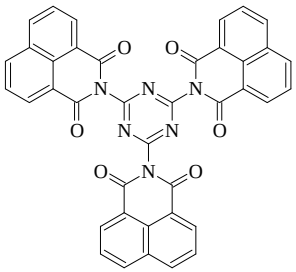
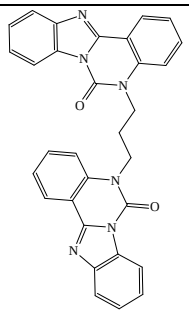
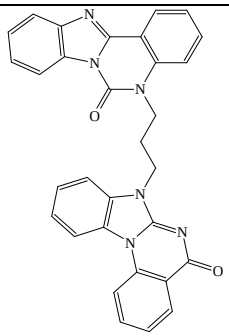
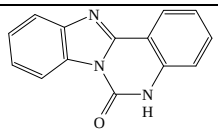
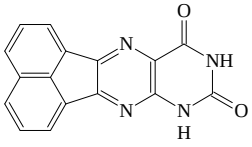
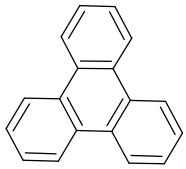
4. An energy storage device according to Claim 3, wherein the polycyclic organic compound is selected from the group consisting of oligophenyl, imidazole, pyrazole, acenaphthene, triaizine, and indanthrone, and the polycyclic organic compound has a general structural formula selected from the group consisting of structures 1–43 as follows:

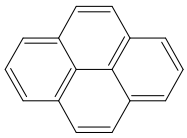
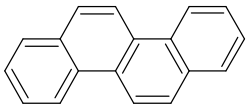
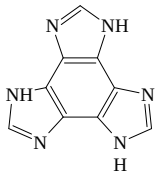
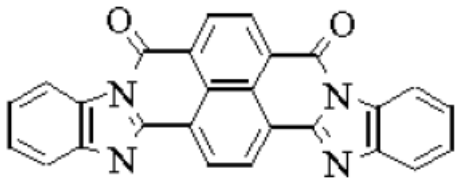
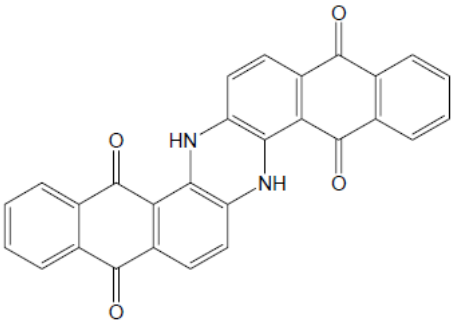
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5. An energy storage device according to Claim 3, wherein the modifying functional groups are selected from the group consisting of alkyl, aryl, substituted alkyl, substituted aryl, and any combination thereof.

6. An energy storage device according to Claim 1, wherein the conductive layers are crystalline.

7. An energy storage device according to Claim 1, wherein the conductive layers comprise material possessing molecular conductivity.

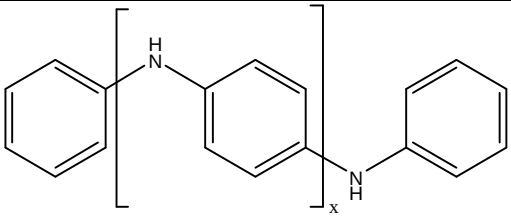
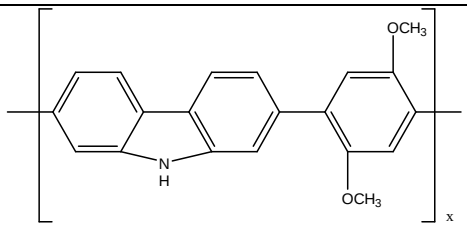
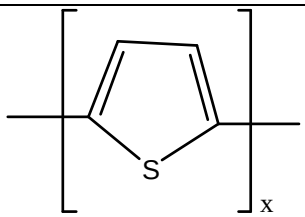
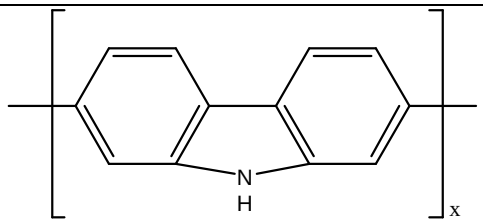
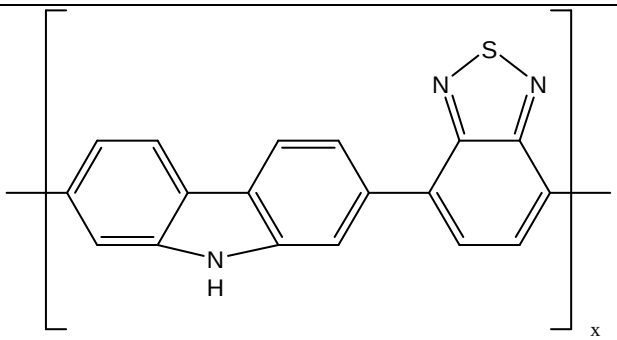
8. An energy storage device according to Claim 7, wherein said conductive layers comprise electroconductive oligomers.

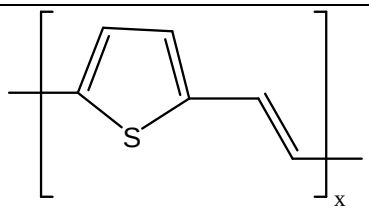
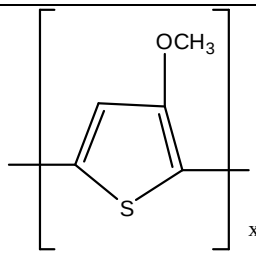
9. An energy storage device according to Claim 8, wherein longitudinal axes of the electroconductive oligomers are directed predominantly perpendicularly to the electrodes.

10. An energy storage device according to Claim 8, wherein longitudinal axes of the electroconductive oligomers are directed predominantly parallel to the electrodes.

11. An energy storage device according to Claim 8, wherein the electroconductive oligomers predominantly possess lateral translational symmetry.

12. An energy storage device according to Claim 8, wherein the electroconductive oligomers are selected from the group consisting of structures 50 to 56 as follows:

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where X = 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12

13. An energy storage device according to Claim 8, wherein the electroconductive oligomers further comprise substitute groups and are described by the following general structural formula II:

$$(\text{electroconductive oligomer})\text{--}R_q \qquad \text{(II)}$$

where R_q is a set of substitute groups, and q is a number of the substitute groups R in the set R_q., q equals to 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10.

14. An energy storage device according to Claim 13, wherein the substitute groups R are independently selected from the group consisting of alkyl, aryl, substituted alkyl, substituted aryl, and any combination thereof.

15. An energy storage device according to Claim 1, wherein insulating layer thickness (d_{ins}), conductive layer thickness (d_{cond}), number of the insulating layers ($n_{ins} \geq 2$), dielectric permittivity of the insulating dielectric material (ε_{ins}) and dielectric permittivity of the conductive layer (ε_{cond}) satisfy the following relation:

$$d_{cond} = p\cdot(n_{ins}/(n_{ins}\text{-}1)\cdot(\varepsilon_{cond}/\varepsilon_{ins})\cdot d_{ins} \text{ , where } p \geq 3$$

16. An energy storage device according to Claim 1, wherein the electrodes comprise Pt, Cu, Al, Ag and/or Au.

17. A method of producing an energy storage device, which comprises the steps of

a) preparation of a conducting substrate serving as a first electrode,

b) formation of a multilayer structure on the first electrode, and

c) formation of a second electrode on the multilayer structure

wherein formation of the multilayer structure comprises alternating steps of application of insulating layers and application of conductive layers or a step of coextrusion of insulating and conductive layers, wherein the multilayer structure is a solid multilayer structure disposed between said first and second electrodes,

wherein said electrodes are flat and planar and positioned parallel to each other, and

wherein said solid multilayer structure comprises ***m*** insulating and conductive layers,

said layers are disposed parallel to said electrodes, and

said layers have the following sequence: A-B-(A-B-…A-B-)A, where

A is a homogeneous insulating layer which comprises an insulating dielectric material,

B is a homogeneous conductive layer, and

m is equal to 3 or more.

18. A method according to Claim 17, wherein the step b) of formation of the multilayer structure comprises alternating steps of the application of a solution of an insulating material and the application of a solution of the conductive material, wherein both application steps are followed by a step of drying to form solid insulating layers and solid conductive layers, the alternating steps are repeated until formation of the multilayer structure is completed, and the insulating layer is formed as the first layer and as the last layer, said first layer and said last layer each being in direct contact with an electrode.

19. A method according to Claim 17, wherein the step b) of formation of the multilayer structure comprises alternating steps of the application of a melt of an insulating material and the application of a melt of the conductive material, wherein both application steps are followed with a step of cooling down to form a solid insulating layer and a solid conductive layer, the alternating steps are repeated until formation of the multilayer structure is completed, and the insulating layer is formed as the first layer and as the last layer, said first layer and said last layer each being in direct contact with an electrode.

20. A method according to Claim 17, wherein the step b) of formation of the solid multilayer structure comprises a step of coextrusion of a set of alternating conductive material layers and insulating dielectric material layers onto the substrate, followed by drying to form the solid multilayer structure.

21. A method according to Claim 17, wherein the step b) of formation of the solid multilayer structure comprises a step of coextrusion of a set of alternating melted conductive

material layers and melted insulating dielectric material layers onto the substrate, followed by the step of cooling down to form the solid multilayer structure.