Patent Claims

1. Electronic component (10) comprising a plurality of switching elements (1) which comprise, in this sequence,
a first electrode (20),
a molecular layer (18) bonded to a substrate, and
a second electrode (16),
where the molecular layer essentially consists of redox-inactive molecules (M) which contain a connecting group (V) and an end group (E) having a polar or ionic function, and wherein the molecules (M) represent one or more compounds of the formula (I),

$$\sim (A)_s\text{-}(V)\text{-}[Y^1\text{-}(Z^1\text{-}Y^2)_m]_t\text{-}(E) \qquad (I)$$

in which

A denotes an anchoring group, via which the connecting group is bonded to the substrate,

V is a linear or branched C_1-C_{25}-alkylene group, in which one or more non-adjacent CH_2 groups may each be replaced by -C=C-, -CH=CH-, -NR'-, -O-, -S-, -CO-, -CO-O-, -O-CO-, -O-CO-O- or by a 3-6-membered saturated or partially unsaturated alicyclic ring or by a 3-6-membered saturated or partially unsaturated heterocyclic ring, where N, O and/or S are not bonded directly to one another, in which one or more tertiary carbon atoms (CH groups) may be replaced by N and in which one or more hydrogen atoms may be replaced by halogen, where R' in each case, independently of one another, denotes H or C_1-C_{12}-alkyl

Y^1 and Y^2 are each, independently of one another, a carbocyclic aromatic or alicyclic group, preferably having 4 to 25 C atoms, which may also contain condensed rings and which may be mono- or polysubstituted by a group R^L;

R^L is in each case independently OH, SH, SR^o, $-(CH_2)_n$-OH, F, Cl, Br, I, -CN, $-NO_2$, -NCO, -NCS, -OCN, -SCN, $-C(=O)N(R^o)_2$, $-C(=O)R^o$, $-N(R^o)_2$, $-(CH_2)_n-N(R^o)_2$, optionally substituted silyl, optionally substituted aryl or cycloalkyl having 6-20 C atoms or linear or branched alkyl, alkoxy, alkylcarbonyl, alkoxycarbonyl, alkylcarbonyloxy or alkoxycarbonyloxy having 1-25 C atoms, in which one or more H atoms may be replaced by F or Cl and in which two vicinal groups R^L together may optionally be =O;

n is 1, 2, 3 or 4;

Z^1 is in each case independently a single bond, -O-, -S-, -CO-, -CO-O-, -O-CO-, -O-CO-O-, $-OCH_2$, $-CH_2O$-, $-SCH_2$-, $-CH_2S$-, $-CF_2O$-, $-OCF_2$-, $-CF_2S$-, $-SCF_2$-, $-(CH_2)_n$-, $-CF_2CH_2$-, $-CH_2CF_2$-, $-(CF_2)_n$-, -CH=CH-, -CF=CF-, -C=C-, -CH=CH-COO-, -OCO-CH=CH- or $-CR^o_2$, preferably a single bond or $-CH_2CH_2$-;

R^o is in each case, independently of one another, H or C_1-C_{12}-alkyl,

m is 0, 1, 2, 3, 4, or 5,

s is 1,

t, is 0 or 1,

~ indicates the bond to the substrate,

and where the connecting group (V) is of flexible conformation and the molecules (M) have a conformation-flexible molecular dipole moment, wherein the dipol moment is a permanent dipole moment of at least 0.5 debye.

2. Electronic component (10) according to Claim 1, where the connecting group (V) is a linear or branched C_1-C_{10}-alkylene group, in which one or more non-adjacent CH_2 groups may each be replaced by -O-, -S-, or a 3-6-membered, saturated alicyclic ring, where O and/or S are not bonded directly to one another, and in which one or more hydrogen atoms may be replaced by F and/or Cl.

3. Electronic component (10) according to Claim 1 or 2, where the end group (E) is a polar end group which has at least one bond in which the electronegativity difference between the atoms involved is at least 0.5.

4. Electronic component (10) according to Claim 3, where the end group (E) is a polar end group selected from CN, SCN, NO_2, (C_1-C_4)-haloalkyl, preferably CF_3, (C_1-C_4)-haloalkoxy, preferably OCF_3, -S-(C_1-C_4)-haloalkyl, preferably SCF_3, $S(O)_2$-(C_1-C_4)-haloalkyl, preferably SO_2CF_3, SF_5, OSF_5, $N(C_1$-C_4-haloalkyl$)_2$, preferably $N(CF_3)_2$, $N(CN)_2$ and (C_6-C_{12})-haloaryl, preferably mono-, di- or trifluorophenyl.

5. Electronic component (10) according to Claim 1 or 2, where the end group (E) is a redox-inactive cationic or anionic group.

6. Electronic component (10) according to Claim 5, where the end group (E) is a redox-inactive, weakly coordinating cationic or anionic group.

7. Electronic component (10) according to Claim 5 or 6, where the end group (E) is a cationic or anionic group selected from imidazolium, pyridinium, pyrrolidinium, guanidinium, uronium, thiouronium, piperidinium, morpholinium, ammonium and phosphonium groups or halides, borates, sulfonates, carboxylates, phosphates, phosphinates, perfluorinated alkylsulfonates and -carboxylates, imide anions and amide anions, preferably optionally substituted tetraphenylborates,

tetrafluoroborate, trifluoroacetate, triflate, hexafluorophosphate, phosphinates and optionally substituted tosylates.

8. Electronic component (10) according to Claim 7, where the counterions of the cationic or anionic groups are selected from the anionic or cationic groups respectively indicated in Claim 7.

9. Electronic component (10) according to one or more of claims 1 to 8, where the anchor group (A) is bonded to the substrate via a covalent bond.

10. Electronic component (10) according to one or more of claims 1 to 8, where the anchor group (A) is bonded to the substrate by physisorption.

11. Electronic component (10) according to Claim 9 or 10, where the anchor group (A) is selected from carboxylate, phosphonate, alcoholate, arylate, preferably phenolate, thiolate and sulfonate groups or fullerene derivatives, preferably [60]PCBM (methyl [6,6]-phenyl-C61-butanoate) and [70]PCBM (methyl [6,6]-phenyl-C71-butanoate).

12. Electronic component (10) according to one of Claims 1 to 11, characterised in that the molecular layer is a molecular monolayer.

13. Electronic component (10) according to one of Claims 1 to 12, characterised in that the first electrode (20) represents the substrate for the molecular layer.

14. Electronic component (10) according to one of Claims 1 to 13, characterised in that the first electrode (20) consists of a material selected from element semiconductors, preferably Si, Ge, C (diamond, graphite, graphene), Sn (alpha modification) and Se, compound semiconductors from groups III-V, preferably GaAs, InAs, InP, GaSb and GaN, and compound semiconductors from groups II-VI,

preferably CdSe and ZnS, in various doping, metals, preferably Au, Ag, Cu, Al and Mg, and conductive, oxidic materials, preferably ITO, IGO, IGZO, AZO and FTO.

15. Electronic component (10) according to one of Claims 1 to 14, characterised in that the molecular layer is bonded to an oxidic or fluoridic interlayer.

16. Electronic component (10) according to Claim 15, characterised in that the oxidic or fluoridic interlayer is formed from TiO_2, Al_2O_3, HfO_2, SiO_2 or LiF.

17. Electronic component (10) according to one of Claims 1 to 16, characterised in that the second electrode (16) consists of a conducting or semiconducting material or a combination of a plurality of these materials selected from Hg, In, Ga, InGa, Ag, Au, Cr, Pt, PdAu, Pb, Al, Mg, CNT, graphene and conductive polymers.

18. Electronic component (10) according to one of Claims 1 to 17, characterised in that the first electrode (20) and the second electrode (16) are metallic conductors or in that the second electrode (16) is a metallic conductor and the first electrode (20) is semiconducting.

19. Electronic component (10) according to one of Claims 1 to 18, characterised in that a diode (22) is arranged between the first electrode (20) and the molecular layer (18) or between the second electrode (16) and the molecular layer (18).

20. Electronic component (10) according to Claim 19, characterised in that the diode (22) comprises an n^+-doped layer (24) and a p^+-doped layer (26), where the n^+-doped layer (24) or the p^+-doped layer (26) is in the form of a combined electrode together with a semiconducting first electrode (20).

21. Electronic component (10) according to one of Claims 1 to 20, characterised in that an interlayer is arranged between the second elec-

trode (16) and the molecular layer (18) or between the diode (22) and the molecular layer (18), where the interlayer is selected from an oxidic or fluoridic material.

22. Electronic component (10) according to one of Claims 1 to 21, characterised in that the component (10) has a multiplicity of switching elements (1), where the first electrodes (20) and second electrodes (16) of the switching elements (1) form a crossbar array.

23. Electronic component (10) according to one of Claims 1 to 22, characterised in that the switching elements are set up to change between a state having high electrical resistance and a state having low electrical resistance, where the quotient between high electrical resistance and low electrical resistance is between 10 and 100,000.

24. Electronic component according to one of Claims 1 to 23, characterised in that it is designed as a memristive component.

25. Method for operating an electronic component (10) according to one of Claims 1 to 24, characterised in that a switching element (1) of the electronic component (10) is switched into a state of high electrical resistance by setting a corresponding first electrode (20) to a first electrical potential and setting a corresponding second electrode (16) to a second electrical potential, where the value of the voltage between the two electrodes (16, 20) is greater than a first switching voltage and the first potential is greater than the second potential, a switching element (1) of the electronic component (10) is switched into a state of low electrical resistance by setting a corresponding first electrode (20) to a third electrical potential and setting a corresponding second electrode (16) to a fourth electrical potential, where the value of the voltage between the two electrodes (16, 20) is greater than a second switching voltage and the fourth potential is greater than the third potential, and the state of a switching element is determined by applying a reading voltage whose value is smaller than the first and second switching voltages between corresponding electrodes (16, 20) and measuring the current flowing.

26. Use of a molecular layer according to one of Claims 1 to 12 in a memristive electronic component.