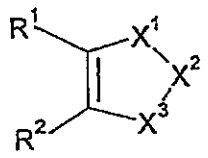
Patent Claims

1. Process comprising the steps of

providing in an electronic device one or more electrodes containing a metal or metal oxide, and

depositing onto the surface of said electrodes a layer comprising a compound of formula I, and

depositing onto the surface of said electrodes which is covered by said layer comprising the compound of formula I, or depositing in the area between two or more of said electrodes, an organic semiconductor,



I

wherein

X^1, X^2, X^3 are independently of each other selected from -N(H)-, -N=, =N-, -C(R^x)=, =C(R^x)- and -S-, wherein at least one of X^1, X^2 and X^3 is different from -C(R^x)= and =C(R^x)-,

R^x is on each occurrence identically or differently H, SH, NH_2, or straight-chain or branched alkyl with 1 to 15 C atoms, in which one or more non-adjacent C atoms are optionally replaced by -O-, -S-, -NR^0-, -CO-, -CO-O-, -O-CO-, O-CO-O-, -CR^0=CR^{00}- or -C≡C- and in which one or more H atoms are optionally replaced by F, Cl, Br, I or CN,

R^1 and R^2 are independently of each other F, Cl, P-Sp-, or straight-chain or branched alkyl with 1 to 15 C atoms, in which one or more non-adjacent C atoms are optionally replaced by -O-, -S-, -NR^0-, -CO-, -CO-O-, -O-CO-, -O-CO-O-, -CR^0=CR^{00}- or -C≡C- and in which one or more H atoms are optionally replaced by F, Cl, Br, I or CN, or denote aryl, heteroaryl, aryloxy, heteroaryloxy, arylcarbonyl, heteroarylcarbonyl, arylcarbonyloxy,

heteroarylcarbonyloxy, aryloxycarbonyl or heteroaryloxycarbonyl having 2 to 30 C atoms that is unsubstituted or substituted by one or more non-aromatic groups R, or R^1 and R^2, together with each other and with the 5-membered heterocycle to which they are attached, form an aromatic or heteroaromatic ring that comprises 5 to 7 ring atoms and is unsubstituted or substituted by 1, 2, 3, 4 or 5 groups R,

R^0 and R^{00} are independently of each other H or optionally substituted carbyl or hydrocarbyl optionally comprising one or more hetero atoms,

R is on each occurrence identically or differently H, P-Sp-, halogen, -CN, -NC, -NCO, -NCS, -OCN, -SCN, -$C(=O)NR^0R^{00}$, -$C(=O)X^0$, -$C(=O)R^0$, -NH_2, -NR^0R^{00}, -SH, -SR^0, -SO_3H, -SO_2R^0, -OH, -NO_2, -CF_3, -SF_5, optionally substituted silyl, carbyl or hydrocarbyl with 1 to 40 C atoms that is optionally substituted and optionally comprises one or more hetero atoms,

P is a polymerisable or crosslinkable group,

Sp is a spacer group or a single bond,

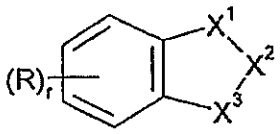
X^0 is halogen.

2. Process according to claim 1, characterized in that in the compounds of formula I R^1 and R^2, together with each other and with the 5-membered heterocycle to which they are attached, form a benzene ring wherein one or two CH groups are optionally replaced by N, and wherein said ring is unsubstituted or substituted by 1, 2, 3 or 4 groups R.

3. Process according to claim 1 or 2, characterized in that in the compounds of formula I R^1 and R^2, together with each other and with

the 5-membered heterocycle to which they are attached, form a benzene, pyridine or pyrimidine ring which is unsubstituted or substituted by 1, 2, 3 or 4 non-aromatic groups R.

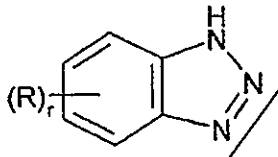
4. Process according to one or more of claims 1 to 3, characterized in that the compounds of formula I are selected of formula I1



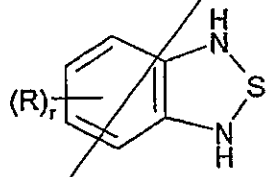
I1

wherein
X^1 is -N(H)-, -C(R^x)=-, or -S-,
X^2 is -N=, -N(H)-, -C(R^x)= or -S-,
X^3 is -N= or -N(H)-,
r is 0, 1, 2, 3 or 4,
and R^x, and R have the meanings given in claim 1.

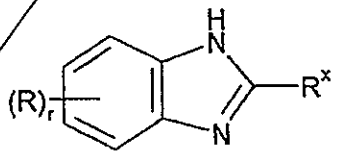
5. Process according to one or more of claims 1 to 4, characterized in that the compound of formula I is selected of the following formulae



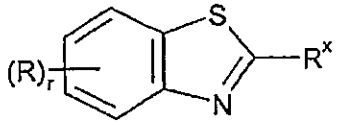
I11



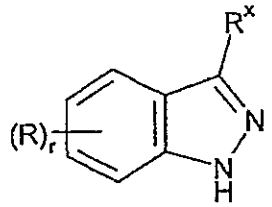
I12



I13



I14



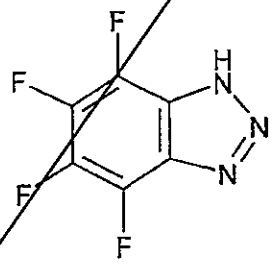
I15

wherein R^x, R and r are as defined in claim 4.

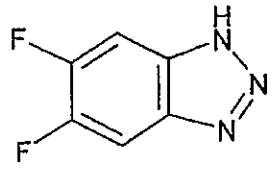
6. Process according to one or more of claims 1 to 5, characterized in that in formula I, I1 and I11-I15 R^x is H, SH, NH_2, -alkylene-SH, wherein alkylene denotes a straight-chain or branched alkylene group with 1 to 18 C atoms, or C_1-C_{18} thiaalkyl, and R denotes, on each occurrence identically or differently, F or C_1-C_{15} perfluoroalkyl.

7. Process according to one or more of claims 1 to 5, characterized in that in formula I, I1 and I11-I15 at least one group R^x or R denotes P-Sp-, wherein P and Sp are as defined in claim 1.

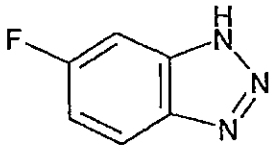
8. Process according to one or more of claims 1 to 7, characterized in that the compound of formula I is selected of the following formulae



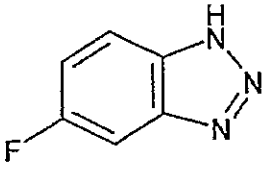
I11a



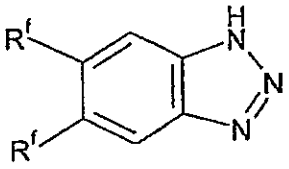
I11b



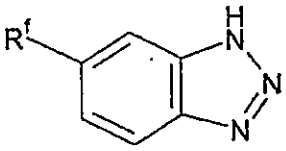
I11c



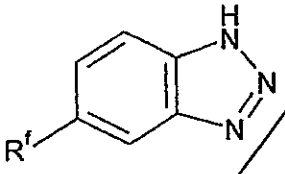
I11d



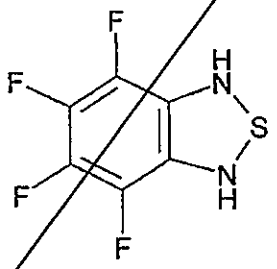
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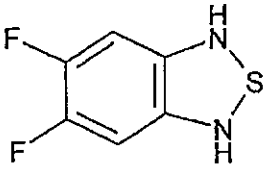
I11f



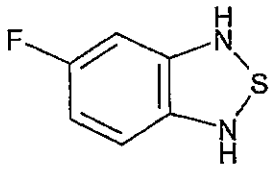
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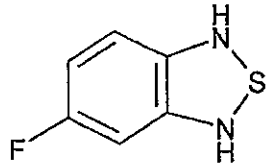
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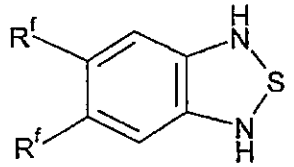
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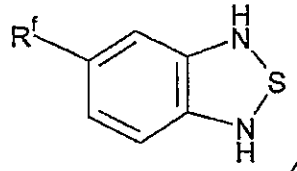
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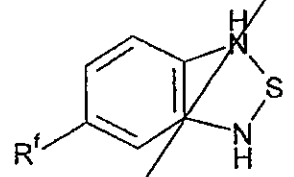
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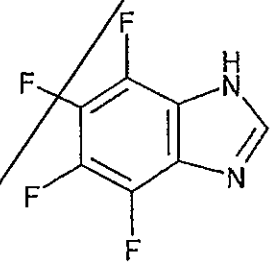
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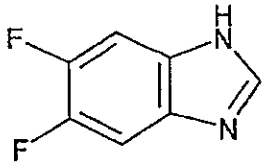
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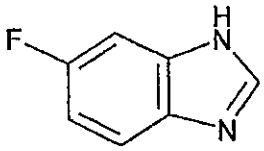
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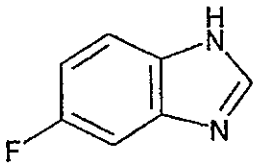
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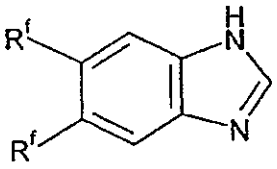
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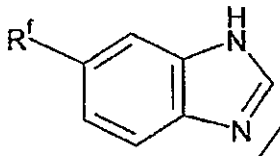
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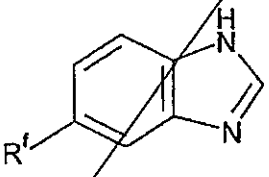
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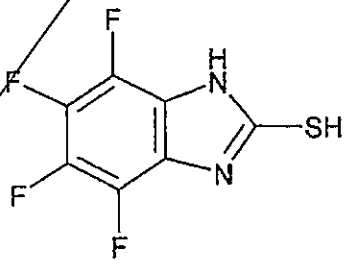
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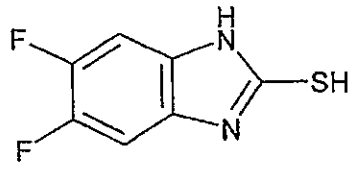
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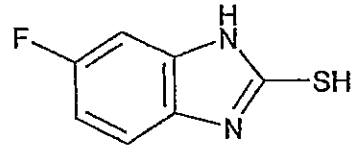
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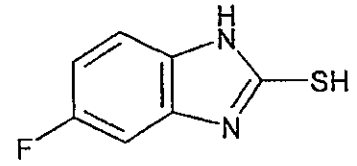
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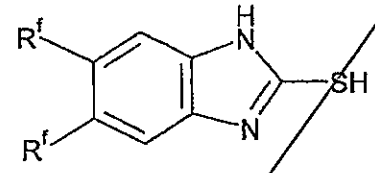
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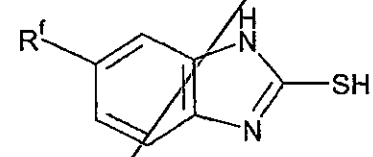
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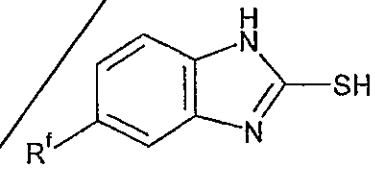
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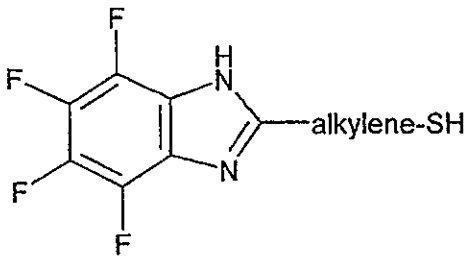
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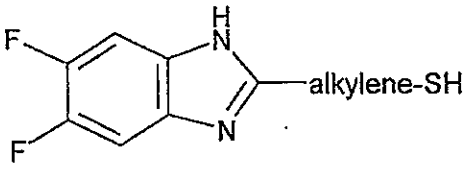
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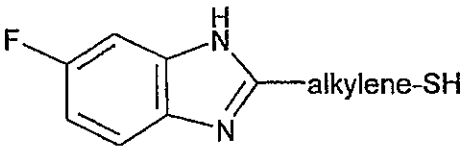
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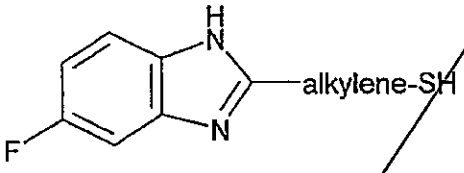
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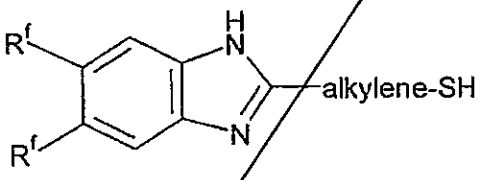
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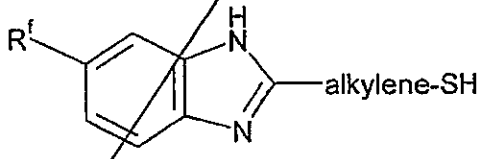
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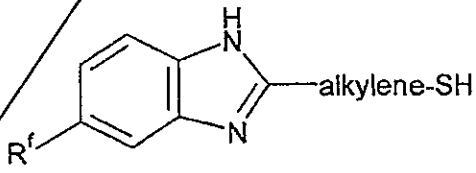
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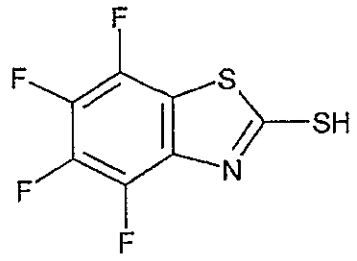
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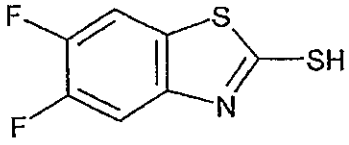
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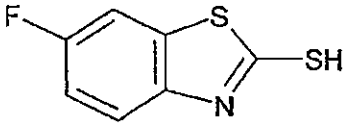
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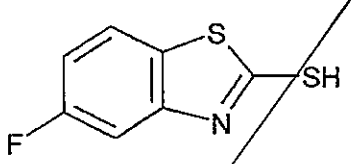
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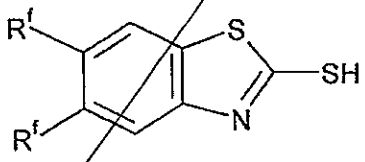
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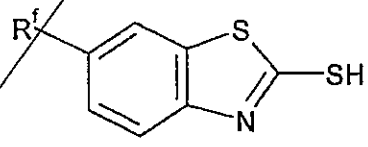
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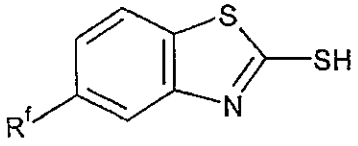
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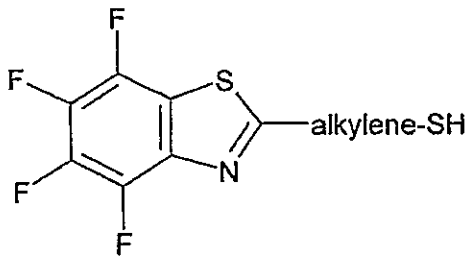
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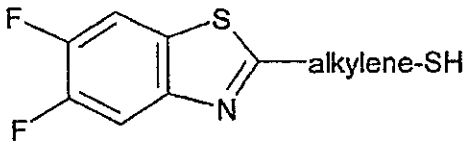
I14f



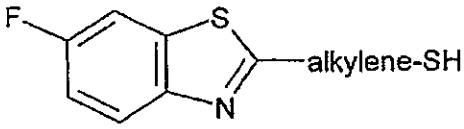
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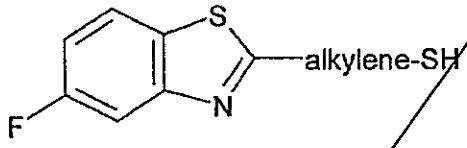
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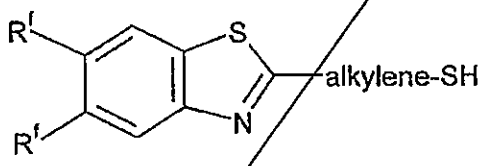
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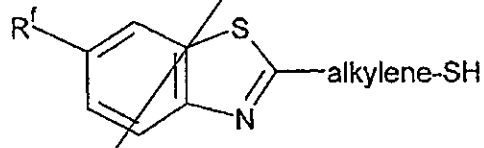
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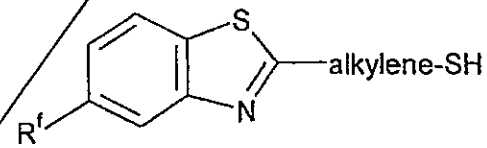
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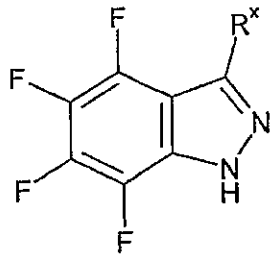
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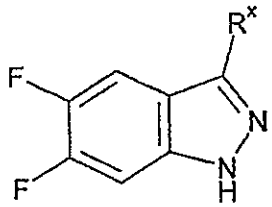
I14o



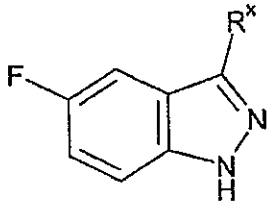
I14p



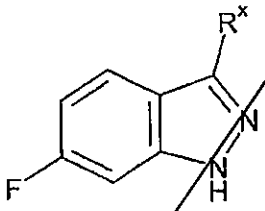
I15a



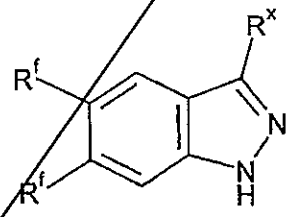
I15b



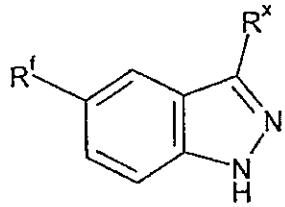
I15c



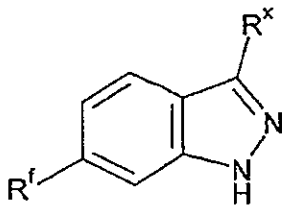
I15d



I15e



I15f



I15g

wherein R^f is straight chain or branched perfluoroalkyl having 1 to 15 C atoms, and alkylene and R^x are as defined in claim 5, 6 or 7.

9. Process according to one or more of claims 1 to 8, characterized in that it comprises the following steps

a) depositing source and drain electrodes onto a substrate, or onto a gate insulator layer,

b) optionally washing the source and drain electrodes,

c) depositing a layer of a compound of formula I, or of a formulation comprising a compound of formula I and optionally one or more solvents, in the area between the source and drain electrodes, and optionally onto the surface of the source and drain electrodes, optionally removing any solvents present, and optionally annealing the layer of the compound of formula I,

d) depositing a layer of an organic semiconductor (OSC), or of a formulation comprising an OSC, onto the source and drain electrodes and onto the layer containing the compound of formula I, optionally removing the solvents still present, and optionally annealing the OSC layer,

wherein optionally steps b) and c) are combined in a single step.

10. Process according to one or more of claims 1 to 9, characterized in that it comprises the following steps

a) depositing source and drain electrodes onto a substrate,

b) optionally washing the source and drain electrodes,

c) depositing a layer of a compound of formula I, or of a formulation comprising a compound of formula I and optionally one or more

solvents, in the area between the source and drain electrodes, and optionally onto the surface of the source and drain electrodes, optionally removing any solvents present, and optionally annealing the layer of the compound of formula I,

d) depositing a layer of an organic semiconductor (OSC), or of a formulation comprising an OSC, onto the source and drain electrodes and onto the layer containing the compound of formula I, optionally removing the solvents still present, and optionally annealing the OSC layer,

e) depositing a gate insulator layer onto the OSC layer,

f) depositing a gate electrode onto the gate insulator layer,

g) optionally depositing a passivation layer onto the gate electrode,

wherein optionally steps b) and c) are combined in a single step.

11. Formulation comprising one or more compounds of formula I as defined in one or more of claims 1 to 8, and further comprising one or more organic or inorganic acids.

12. Organic electronic device obtained by a process according to at least one of claims 1 to 10.

13. Organic electronic device according to claim 12, characterized in that it is selected from the group consisting of organic field effect transistors (OFET), organic thin film transistors (OTFT), components of integrated circuitry (IC), radio frequency identification (RFID) tags, organic light emitting diodes (OLED), electroluminescent displays, flat panel displays, backlights, photodetectors, sensors, logic circuits, memory elements, capacitors, organic photovoltaic (OPV) cells, charge injection layers, Schottky diodes, planarising layers, antistatic films, conducting substrates or patterns, photoconductors, photoreceptors, electrophotographic devices and xerographic devices.

14. Electronic device according to claim 12 or 13, characterized in that it is a top gate or bottom gate OFET.

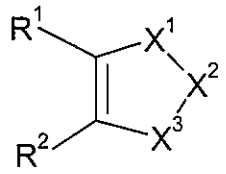
Patent Claims

1. Process comprising the steps of

providing in an electronic device one or more electrodes containing a metal or metal oxide, and

depositing onto the surface of said electrodes a layer comprising a compound of formula I, and

depositing onto the surface of said electrodes which is covered by said layer comprising the compound of formula I, or depositing in the area between two or more of said electrodes, an organic semiconductor,



I

wherein

X^1, X^2, X^3 are independently of each other selected from -N(H)-, -N=, =N-, -C(R^x)=, =C(R^x)- and -S-, wherein at least one of X^1, X^2 and X^3 is different from -C(R^x)= and =C(R^x)-,

R^x is on each occurrence identically or differently H, NH_2, or straight-chain or branched alkyl with 1 to 15 C atoms, in which one or more non-adjacent C atoms are optionally replaced by -O-, -NR^0-, -CO-, -CO-O-, -O-CO-, O-CO-O-, -CR^0=CR^{00}- or -C≡C- and in which one or more H atoms are optionally replaced by F, Cl, Br, I or CN,

R^1 and R^2 are independently of each other F, Cl, P-Sp-, or straight-chain or branched alkyl with 1 to 15 C atoms, in which one or more non-adjacent C atoms are optionally replaced by -O-, -NR^0-, -CO-, -CO-O-, -O-CO-, -O-CO-O-, -CR^0=CR^{00}- or -C≡C- and in which one or more H atoms are optionally replaced by F, Cl, Br, I or CN, or denote aryl, heteroaryl, aryloxy, heteroaryloxy, arylcarbonyl, heteroarylcarbonyl, arylcarbonyloxy, heteroarylcarbonyloxy, aryloxycarbonyl or

heteroaryloxycarbonyl having 2 to 30 C atoms that is unsubstituted or substituted by one or more non-aromatic groups R, or R^1 and R^2, together with each other and with the 5-membered heterocycle to which they are attached, form an aromatic or heteroaromatic ring that comprises 5 to 7 ring atoms and is unsubstituted or substituted by 1, 2, 3, 4 or 5 groups R,

R^0 and R^{00} are independently of each other H or optionally substituted carbyl or hydrocarbyl optionally comprising one or more hetero atoms,

R is on each occurrence identically or differently H, P-Sp-, halogen, -CN, -NC, -NCO, -NCS, -OCN, -SCN, -$C(=O)NR^0R^{00}$, -$C(=O)X^0$, -$C(=O)R^0$, -NH_2, -NR^0R^{00}, -SR^0, -SO_3H, -SO_2R^0, -OH, -NO_2, -CF_3, -SF_5, optionally substituted silyl, carbyl or hydrocarbyl with 1 to 40 C atoms that is optionally substituted and optionally comprises one or more hetero atoms,

P is a polymerisable or crosslinkable group,

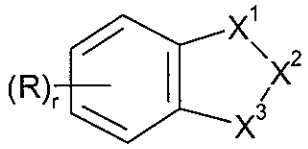
Sp is a spacer group or a single bond,

X^0 is halogen.

2. Process according to claim 1, characterized in that in the compounds of formula I R^1 and R^2, together with each other and with the 5-membered heterocycle to which they are attached, form a benzene ring wherein one or two CH groups are optionally replaced by N, and wherein said ring is unsubstituted or substituted by 1, 2, 3 or 4 groups R.

3. Process according to claim 1 or 2, characterized in that in the compounds of formula I R^1 and R^2, together with each other and with the 5-membered heterocycle to which they are attached, form a benzene, pyridine or pyrimidine ring which is unsubstituted or substituted by 1, 2, 3 or 4 non-aromatic groups R.

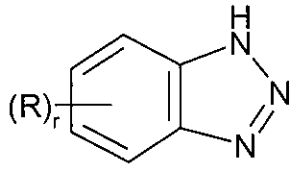
4. Process according to one or more of claims 1 to 3, characterized in that the compounds of formula I are selected of formula I1



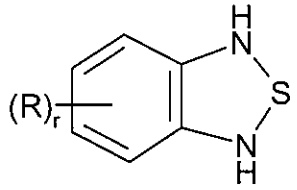
I1

wherein
X^1 is -N(H)-, -C(R^x)=-, or -S-,
X^2 is -N=, -N(H)-, -C(R^x)= or -S-,
X^3 is -N= or -N(H)-,
r is 0, 1, 2, 3 or 4,
and R^x, and R have the meanings given in claim 1.

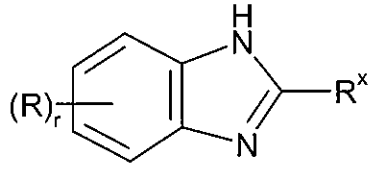
5. Process according to one or more of claims 1 to 4, characterized in that the compound of formula I is selected of the following formulae



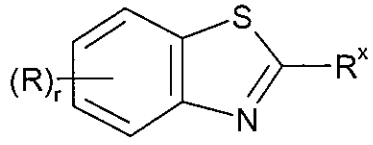
I11



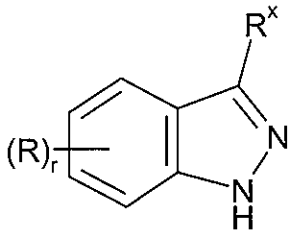
I12



I13



I14



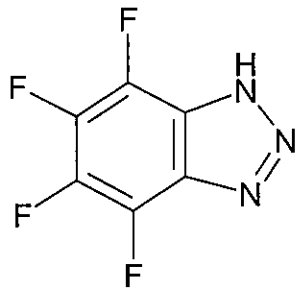
I15

wherein R^x, R and r are as defined in claim 4.

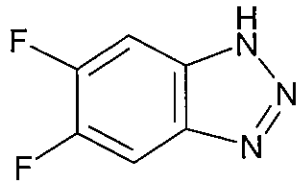
6. Process according to one or more of claims 1 to 5, characterized in that in formula I, I1 and I11-I15 R^x is H, NH_2, and R denotes, on each occurrence identically or differently, F or C_1-C_{15} perfluoroalkyl.

7. Process according to one or more of claims 1 to 5, characterized in that in formula I, I1 and I11-I15 at least one group R^x or R denotes P-Sp-, wherein P and Sp are as defined in claim 1.

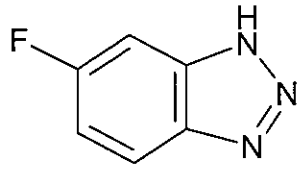
8. Process according to one or more of claims 1 to 7, characterized in that the compound of formula I is selected of the following formulae



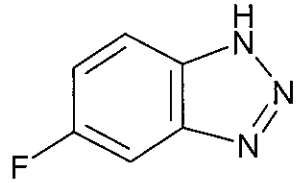
I11a



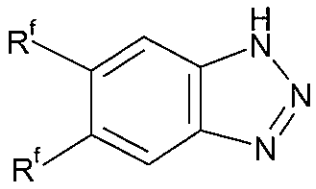
I11b



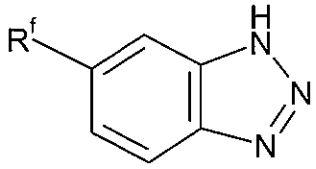
I11c



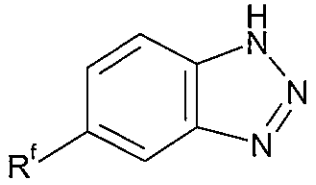
I11d



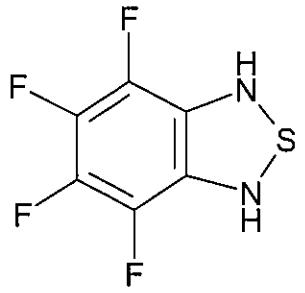
I11e



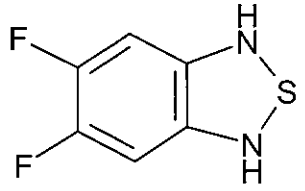
I11f



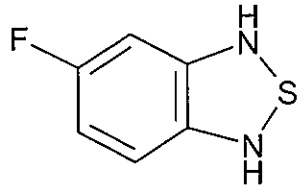
I11g



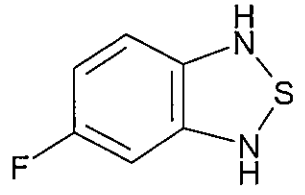
I12a



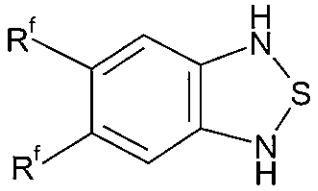
I12b



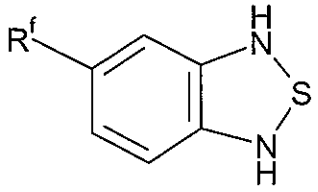
I12c



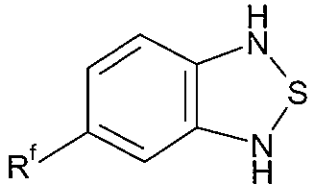
I12d



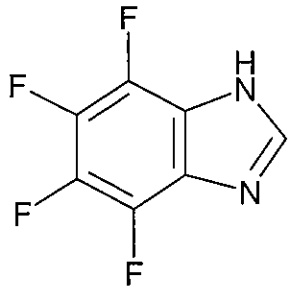
I12e



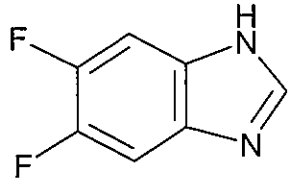
I12f



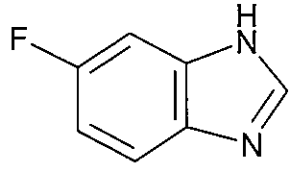
I12g



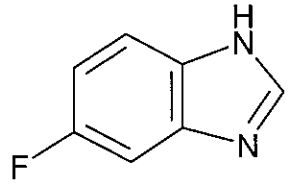
I13a



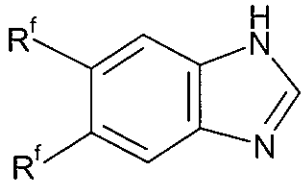
I13b



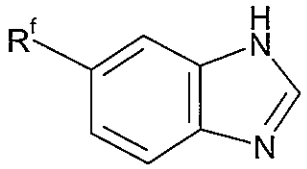
I13c



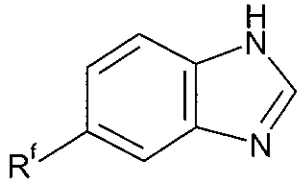
I13d



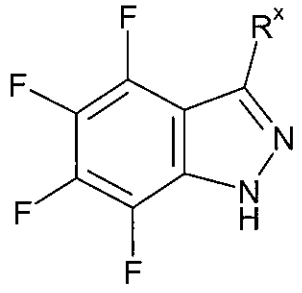
I13e



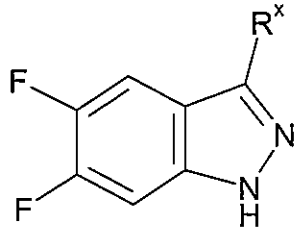
I13f



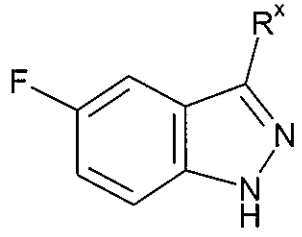
I13g



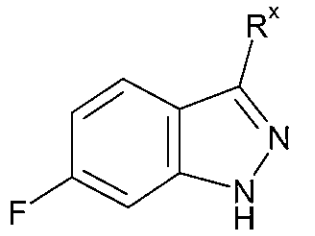
I15a



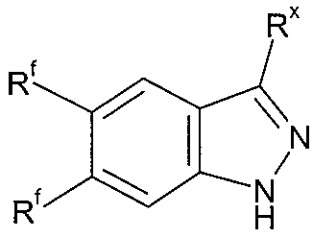
I15b



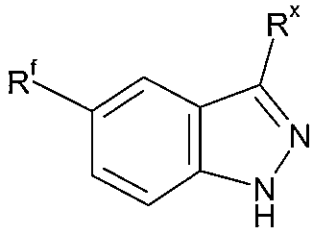
I15c



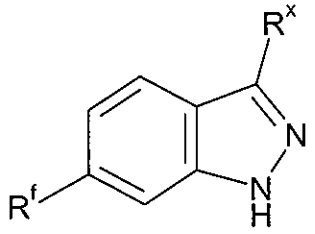
I15d



I15e



I15f



I15g

wherein R^f is straight chain or branched perfluoroalkyl having 1 to 15 C atoms, and alkylene and R^x are as defined in claim 5, 6 or 7.

9. Process according to one or more of claims 1 to 8, characterized in that it comprises the following steps

a) depositing source and drain electrodes onto a substrate, or onto a gate insulator layer,

b) optionally washing the source and drain electrodes,

c) depositing a layer of a compound of formula I, or of a formulation comprising a compound of formula I and optionally one or more solvents, in the area between the source and drain electrodes, and optionally onto the surface of the source and drain electrodes, optionally removing any solvents present, and optionally annealing

the layer of the compound of formula I,

d) depositing a layer of an organic semiconductor (OSC), or of a formulation comprising an OSC, onto the source and drain electrodes and onto the layer containing the compound of formula I, optionally removing the solvents still present, and optionally annealing the OSC layer,

wherein optionally steps b) and c) are combined in a single step.

10. Process according to one or more of claims 1 to 9, characterized in that it comprises the following steps

a) depositing source and drain electrodes onto a substrate,

b) optionally washing the source and drain electrodes,

c) depositing a layer of a compound of formula I, or of a formulation comprising a compound of formula I and optionally one or more solvents, in the area between the source and drain electrodes, and optionally onto the surface of the source and drain electrodes, optionally removing any solvents present, and optionally annealing the layer of the compound of formula I,

d) depositing a layer of an organic semiconductor (OSC), or of a formulation comprising an OSC, onto the source and drain electrodes and onto the layer containing the compound of formula I, optionally removing the solvents still present, and optionally annealing the OSC layer,

e) depositing a gate insulator layer onto the OSC layer,

f) depositing a gate electrode onto the gate insulator layer,

g) optionally depositing a passivation layer onto the gate electrode,

wherein optionally steps b) and c) are combined in a single step.

11. Formulation comprising one or more compounds of formula I as defined in one or more of claims 1 to 8, and further comprising one or more organic or inorganic acids.

12. Organic electronic device obtained by a process according to at least one of claims 1 to 10.

13. Organic electronic device according to claim 12, characterized in that

it is selected from the group consisting of organic field effect transistors (OFET), organic thin film transistors (OTFT), components of integrated circuitry (IC), radio frequency identification (RFID) tags, organic light emitting diodes (OLED), electroluminescent displays, flat panel displays, backlights, photodetectors, sensors, logic circuits, memory elements, capacitors, organic photovoltaic (OPV) cells, charge injection layers, Schottky diodes, planarising layers, antistatic films, conducting substrates or patterns, photoconductors, photoreceptors, electrophotographic devices and xerographic devices.

14. Electronic device according to claim 12 or 13, characterized in that it is a top gate or bottom gate OFET.