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(71) Applicant *(for all designated States except US)*: **CIBA SPECIALTY CHEMICALS HOLDING INC.** [CH/CH]; Klybeckstrasse 141, CH-4057 Basel (CH).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **BACHER, Jean-Pierre** [FR/FR]; rue des Vergers 9, F-68220 Buschwiller (FR). **PARKS, Timothy** [GB/DE]; Am Weiher 3, 79585 Steinen-Weitenau (DE). **WOLLEB, Heinz** [CH/CH]; Steinenbühlstrasse 173, CH-4232 Fehren (CH). **WENDEBORN, Frédérique** [FR/FR]; 59 Grand'Rue, F-68220 Ranspach-le-Haut (FR).

(74) Common Representative: **CIBA SPECIALTY CHEMICALS HOLDING INC.**; Patent Department, Klybeckstrasse 141, CH-4057 Basel (CH).

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(54) **Title:** HIGH CAPACITY OPTICAL STORAGE MEDIA COMPRISING ORGANOMETALLIC ION PAIRS

(57) **Abstract:** Optical recording medium suitable for optical recording with a laser of wavelength from 350 to 500 nm, especially about 405 nm, wherein the recording track comprises a compound of formula $[(L_1)M_1(L_2)]^{m-}\ Z_1^{n+}$ (I), or a mesomeric or tautomeric form thereof, wherein L_1 and L_2 independently of one another are divalent, preferably yellow or orange azo ligands, M_1 is a metal cation in the oxidation state +3, a hydroxy or halogeno metal group wherein the metal is in the oxidation state +4, or an oxo metal group wherein the metal is in the oxidation state +5; m is 1; n is an integer 1, 2 or 3; and Z_1 is a cation selected from a choice of organic chromophores, the absorption maximum of which is mainly in the yellow to orange range.

High capacity optical storage media comprising organometallic ion pairs

The invention relates to new optical recording materials that have excellent recording and playback quality especially at a laser wavelength of 350-500 nm (for example HD DVD™ or Blu-ray Disc™ standards). Recording and playback can be effected very advantageously with high sensitivity, and the storage density that is achievable is significantly higher than in the case of materials recordable at a higher wavelength, such as around 658 ± 5 nm (DVD-R or DVD+R standards). In addition, the materials according to the invention have very good storage properties before and after recording, even under especially harsh conditions, such as exposure to sunlight or fluorescent lighting, heat and/or high humidity. Their manufacture is simple and readily reproducible using customary coating processes, such as spin-coating.

There have been many ideas. For example, EP 1 624 029, EP 1 630 205 and WO 2006 / 024 642 disclose different salts of heterocyclic azo compounds.

WO-2006 / 106 110 is a patent application according to Art. 54(3) EPC and Rule 64.3 PCT.

However, still none of the prior art propositions leads to fully satisfactory results. Especially optical media comprising multiple recording layers do not fully satisfy the increasing technical requirements yet. Moreover, it is not possible yet to achieve all blue laser standards with the same recording dyes, what would be highly desirable because switching from one recording dye to another implies a lot of development work as well as breakdown time for cleaning the production lines, and each dye must be registered as well as certified for each standard. Working in parallel with many dyes on the same plant is undesirable, too.

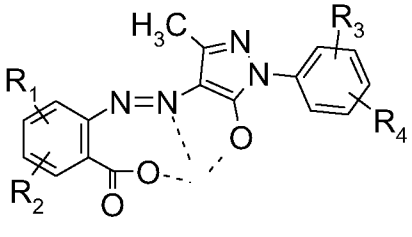
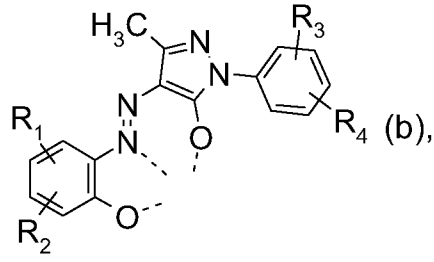
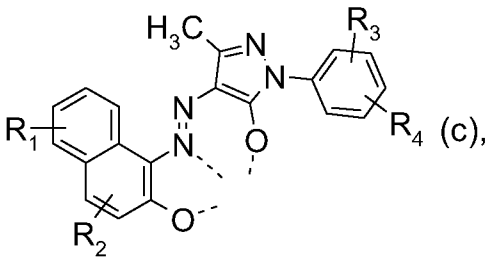
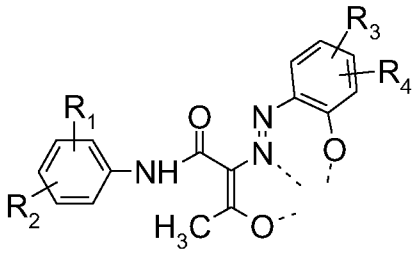
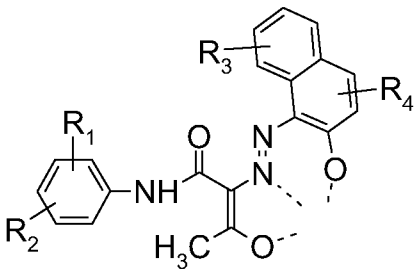
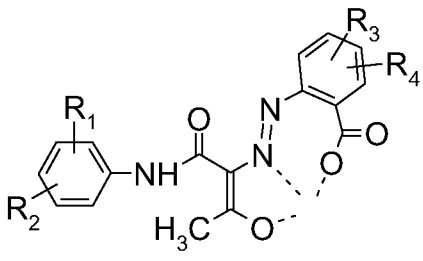
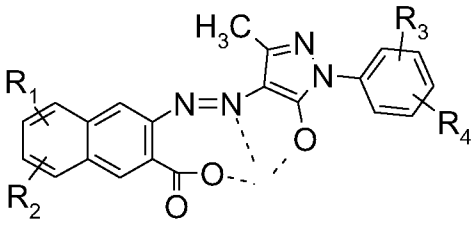
A significant improvement has surprisingly now been obtained by using particular combinations of metal complex anions with cationic chromophores.

The invention accordingly relates to an optical recording medium suitable for optical recording with a laser of wavelength below 600 nm, preferably from 350 to 500 nm, comprising a grooved substrate, a reflecting layer and a recording track of width from 100 to 400 nm, preferably from 150 to 250 nm, depth from 10 to 200 nm, preferably from 20 to 90 nm, and pitch from 250 to 430 nm, preferably from 310 to 400 nm, wherein the recording track comprises a compound of formula

$$[(L_1)M_1(L_2)]^{m-}\ Z_1^{n+}\ (I),$$

or a mesomeric or tautomeric form thereof, wherein

L_1 and L_2 independently of one another are ligands of the formula

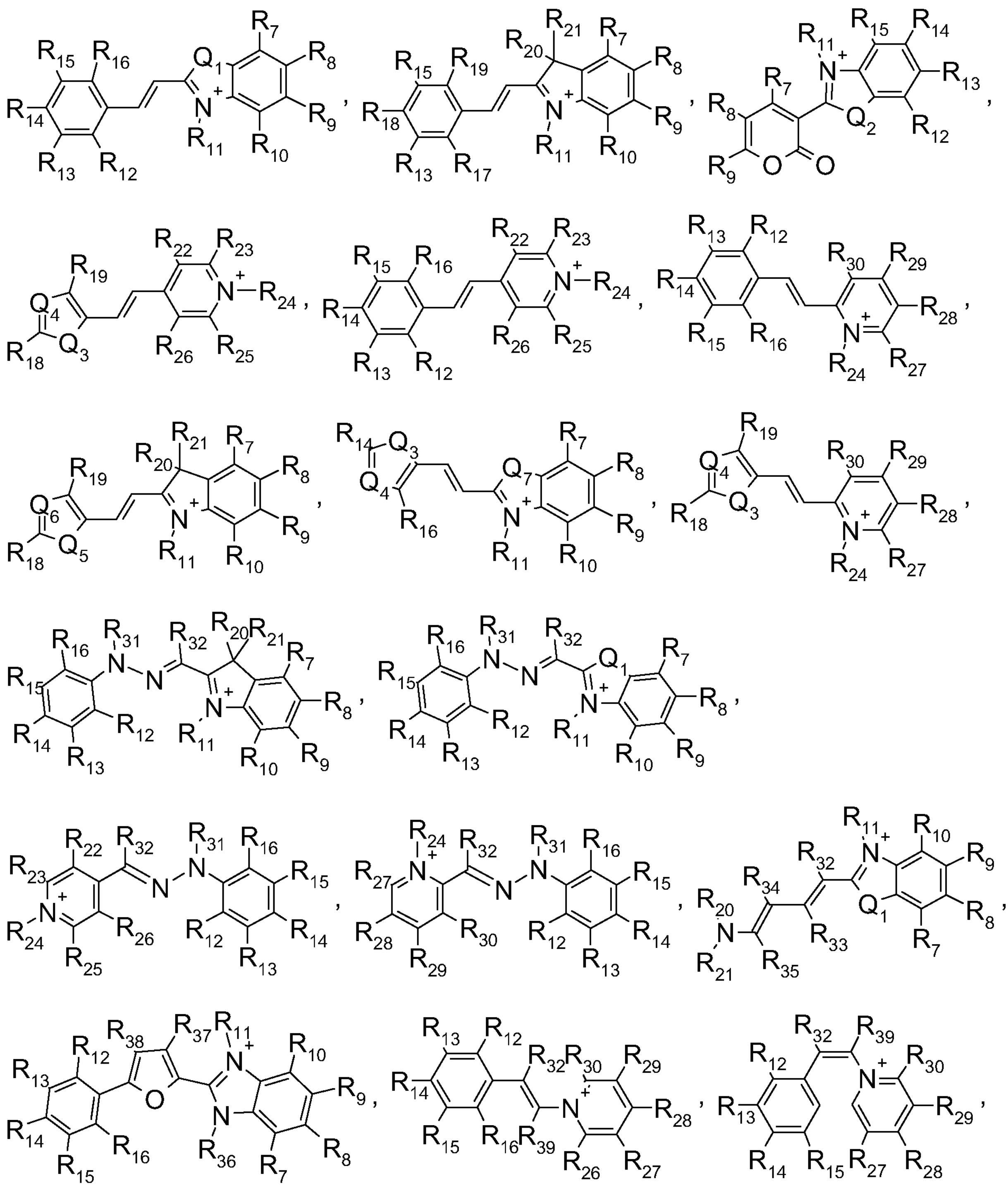

(a),

(b),

(c),

(d),

(e),

(f) or

(g);

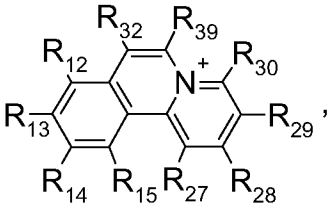
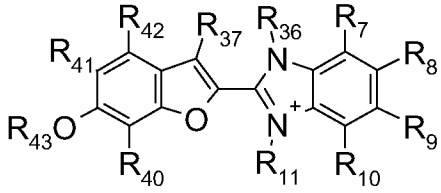
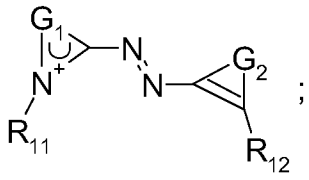
M_1 is a metal cation in the oxidation state +3, a hydroxy or halogeno metal group

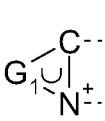
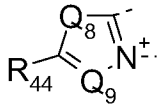
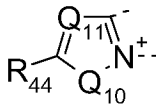
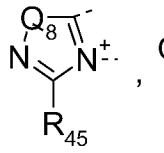
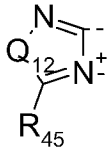
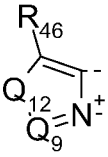
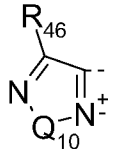
wherein the metal is in the oxidation state +4, or an oxo metal group wherein the metal is in the oxidation state +5, most preferred Cr^{3+} or Co^{3+};

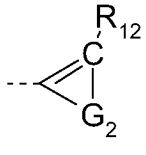
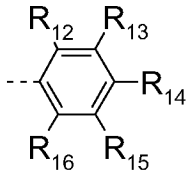
m is the integer 1 ; n is an integer 1, 2 or 3 ;

Z_1 is a cation selected from the group consisting of cations of the formulae





and

;


is

,

,

,

,

or

;


is

or C_2-C_8heteroaryl unsubstituted or mono- or poly-substituted by R_{47}, R_{48}, R_{49} and/or R_{50};

Q_1 and Q_7 are each independently of the other O or S; Q_2 is O, S, $CR_{20}R_{21}$ or NR_{36}; Q_3 and Q_5 are each independently of the other O, S or NR_{51}; Q_4 is N or CR_{52}; Q_6 is N, or is CR_{12} when Q_5 is O or S; Q_8, Q_{10} and Q_{12} are each independently of the other $CR_{53}R_{54}$, O, S or NR_{51}; Q_9 and Q_{11} are each independently of the other CR_{55} or N ;

R_1, R_2, R_3 and R_4 independently of one another are hydrogen, halogen, R_5, NO_2, NR_5R_6, NHCO–R_5, NHCOO–R_5, SO_2–R_5, SO_2NH_2, SO_2NH–R_5, $SO_2NR_5R_6$, SO_3^- or SO_3H;

R_5 and R_6 independently of one another are unsubstituted or hydroxyl-, halo- or C_1-C_6alkoxy-substituted C_1-C_{12}alkyl or C_6-C_{10}aryl;

R_7, R_8, R_9, R_{10}, R_{12}, R_{13}, R_{14}, R_{15}, R_{16}, R_{40}, R_{41}, R_{42}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, R_{49}, R_{50}, R_{52} and R_{55} are each independently of the other H, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{59}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, $OSiR_{51}R_{58}R_{61}$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$, SO_2R_{51}, $SO_2NR_{59}R_{60}$, SO_3R_{59}; C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen,

OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59}; or C_7-C_{11}aralkyl, C_6-C_{10}aryl or C_1-C_8heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51}, NO_2, CN and/or $COOC_1$-C_4alkyl;

R_{11} and R_{36} are independently of each other C_1-C_{20}alkyl, C_3-C_{12}cycloalkyl, C_1-C_{12}heterocycloalkyl, C_2-C_{20}alkenyl, C_3-C_{12}cycloalkenyl, C_4-C_{12}heterocycloalkenyl, C_2-C_{20}alkynyl, C_7-C_{18}aralkyl, C_1-C_9heteroaryl, C_2-C_{17}heteroaralkyl, C_6-C_{12}aryl or C_1-C_{12}alkyl interrupted by from one to five non-successive oxygen and/or sulfur atoms and/or by from one to five identical or different groups NR_{51}, each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{59}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, $OSiR_{51}R_{58}R_{61}$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$, SO_2R_{51}, $SO_2NR_{59}R_{60}$, SO_3R_{59};

R_{17}, R_{18} and R_{19} are each independently of the other H, halogen, OR_{56}, SR_{56}, $OSiR_{51}R_{58}R_{61}$, $CR_{51}OR_{67}OR_{68}$; C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59}; or C_7-C_{11}aralkyl, C_6-C_{10}aryl or C_1-C_8heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51} and/or $COOC_1$-C_4alkyl;

R_{20} and R_{21} are each independently of the other C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_7-C_{12}aralkyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59};

or R_{20} and R_{21} are together C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen, one to five non-successive carbon atoms of which can be replaced by oxygen and/or sulfur atoms and/or by identical or different groups NR_{51}, C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen

being each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59};

R_{22}, R_{23}, R_{25}, R_{26}, R_{27}, R_{28}, R_{29} and R_{30} are each independently of the other H, halogen, COR_{51}, NO_2, CN, SO_3R_{59}; or C_1-C_6alkyl, C_6-C_{12}aryl, C_7-C_{12}aralkyl each unsubstituted or mono- or poly-substituted by halogen, C_1-C_8alkyl and/or SO_3R_{59};

R_{24} is halogen, $COOR_{56}$, $CONR_{59}R_{60}$; or C_1-C_{20}alkyl, C_7-C_{18}aralkyl each unsubstituted or mono- or poly-substituted by halogen, C_1-C_8alkyl, COR_{51}, $COOR_{56}$, $CONR_{59}R_{60}$, OR_{56}, CN and/or SO_3R_{31};

R_{31} is C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_7-C_{12}aralkyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59};

or R_{16} and R_{31} are together with the nitrogen and the carbon atoms joining them together a 5- or a 6-membered ring;

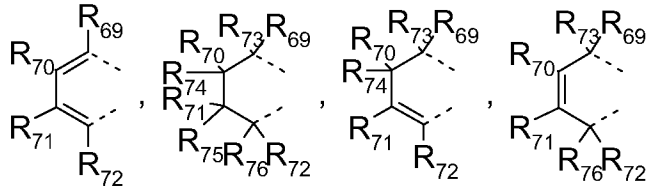
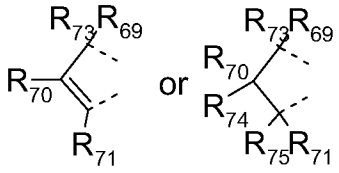
R_{32}, R_{33}, R_{34} and R_{35} are each independently of the other H, CH_3 or C_2H_5 each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62} or $NR_{43}R_{63}$;

R_{37} and R_{38} are each independently of the other H; C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62} or $NR_{43}R_{63}$; or C_7-C_{11}aralkyl, C_6-C_{10}aryl or C_1-C_8heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{62}, SR_{62}, $NR_{43}R_{63}$, COR_{63}, NO_2, CN and/or $COOC_1$-C_4alkyl;

R_{39} is COR_{43}, $COOR_{43}$, $CONR_{64}R_{65}$, CN, $SO_2NR_{64}R_{65}$, SO_2R_{64} or SO_3R_{31}; or is C_1-C_4alkyl mono- or poly-substituted by halogen;

R_{43}, R_{57}, R_{59}, R_{60}, R_{64} and R_{65} are each independently of the others H; C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{66}, SR_{66}, $NR_{61}R_{63}$, CN and/or $COOR_{63}$; or C_6-C_{10}aryl, C_7-C_{11}aralkyl or C_1-C_5heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{66}, SR_{66}, $NR_{61}R_{63}$, COR_{63}, $CR_{63}OR_{67}OR_{68}$, NO_2, CN and/or $COOR_{61}$;

or $NR_{64}R_{65}$ and/or $NR_{59}R_{60}$ is a five- or six-membered heterocycle which may contain a further N or O atom and which can be mono- or poly-substituted by methyl and/or ethyl;

or one or more pairs R_7 and R_8, R_8 and R_9, R_9 and R_{10}, R_{11} and R_{32}, R_{12} and R_{13}, R_{12} and R_{18}, R_{12} and R_{32}, R_{13} and R_{14}, R_{13} and R_{17}, R_{13} and R_{18}, R_{14} and R_{15}, R_{14} and R_{52}, R_{15} and R_{16}, R_{15} and R_{18}, R_{15} and R_{19}, R_{16} and R_{31}, R_{16} and R_{52}, R_{18} and R_{52}, R_{19} and R_{52}, R_{20} and R_{34}, R_{21} and R_{35}, R_{22} and R_{23}, R_{25} and R_{26}, R_{26} and R_{27}, R_{27} and R_{28}, R_{28} and R_{29}, R_{29} and R_{30}, R_{32} and R_{34}, R_{33} and R_{35}, R_{41} and R_{42}, R_{44} and R_{55} and/or R_{47} and R_{48}, are independently from all other of these pairs together a bivalent group of the formula  ,  or , thus forming a benzene, cyclohexene, cyclohexadiene, cyclopentadiene or cyclopentene ring with the two adjacent carbons to which they are bound;

R_{51}, R_{58}, R_{61} and R_{63} are each independently of the others hydrogen, benzyl; or C_1-C_4alkyl, C_2-C_4alkenyl, C_2-C_4alkynyl, $[C_2$-C_3alkylen-O-$]_k$-R_{77} or $[C_2$-C_3alkylen-NR_{78}-$]_k$-R_{77} each unsubstituted or mono- or poly-substituted by halogen;

or $NR_{43}R_{63}$, $NR_{51}R_{57}$, $SiR_{51}R_{58}$ and/or $NR_{61}R_{63}$ is a five- or six-membered heterocycle which may contain a further N or O atom and which can be mono- or

poly-substituted by methyl and/or ethyl;

R_{67} and R_{68} are each independently of the others benzyl; or C_1-C_4alkyl, C_2-C_4alkenyl, C_2-C_4alkynyl, $[C_2$-C_3alkylen-O-$]_k$-R_{77} or $[C_2$-C_3alkylen-NR_{78}-$]_k$-R_{77} each unsubstituted or mono- or poly-substituted by halogen;

k is an integer 1, 2, 3 or 4;

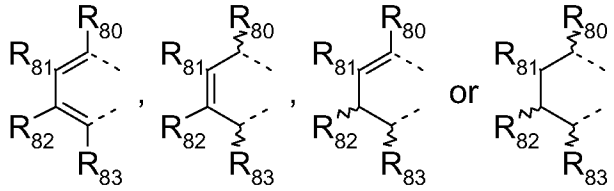
R_{53} and R_{54} are each independently of the other C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_7-C_{12}aralkyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}hetero-cycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62}, $NR_{43}R_{63}$, $NR_{63}COR_{61}$, $NR_{63}COOR_{62}$, $NR_{63}CONR_{64}R_{65}$, $NR_{63}CN$, COR_{63}, $CR_{63}OR_{68}OR_{67}$, NO_2, CN, $COOR_{62}$, $CONR_{64}R_{65}$ and/or SO_2R_{64};

or R_{53} and R_{54} are together as a pair C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen, one to five non-successive carbon atoms of which can be replaced by oxygen and/or sulfur atoms and/or by identical or different groups NR_{63}, C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen being each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62}, $NR_{43}R_{63}$, $NR_{63}COR_{61}$, $NR_{63}COOR_{62}$, $NR_{63}CONR_{64}R_{65}$, $NR_{63}CN$, COR_{63}, $CR_{63}OR_{67}OR_{68}$, NO_2, CN, $COOR_{62}$, $CONR_{64}R_{65}$ and/or SO_2R_{64};

each R_{56} or R_{62}, independently of any other R_{56} or R_{62}, is R_{43} or R_{79};

each R_{66}, independently of any other R_{66}, is independently of the others C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5hetero-cycloalkyl each unsubstituted or mono- or poly-substituted by halogen, $NR_{61}R_{63}$, CN and/or $COOR_{63}$; or C_6-C_{10}aryl, C_7-C_{11}aralkyl or C_1-C_5heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, $NR_{61}R_{63}$, COR_{63}, $CR_{63}OR_{67}OR_{68}$, NO_2, CN and/or $COOR_{61}$;

R_{69}, R_{70}, R_{71} and R_{72} are each independently of the other H, C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51}, NO_2, CN or $COOC_1$-C_4alkyl;

or one or more pairs R_{69} and R_{70}, R_{70} and R_{71} and/or R_{71} and R_{72} are independently from both other pairs together  , thus forming a benzene or a partially or fully saturated 6-membered ring with the two adjacent carbons to which they are bound;

R_{73}, R_{74}, R_{75} and R_{76} are each independently of the other H, C_1-C_4alkyl, halogen, OR_{56} or SR_{56}, it being possible R_{69} to form a 3-, 4-, 5- or 6-membered ring with R_{73}, R_{70} to form a 3-, 4-, 5- or 6-membered ring with R_{74}, R_{71} to form a 3-, 4-, 5- or 6-membered ring with R_{76} or R_{72} to form a 3-, 4-, 5- or 6-membered ring with R_{75}; or R_{69} and R_{73}, R_{70} and R_{74}, R_{71} and R_{75} or R_{72} and R_{76} are together NR_{51}, O or S;

R_{77} and R_{78} are each independently of the other methyl, ethyl, vinyl and/or allyl;

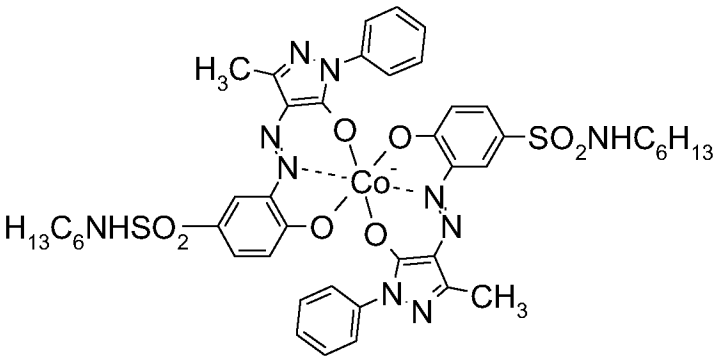
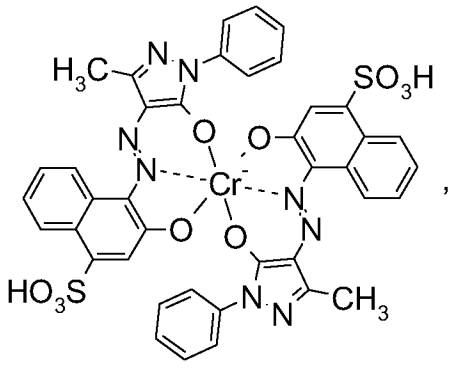
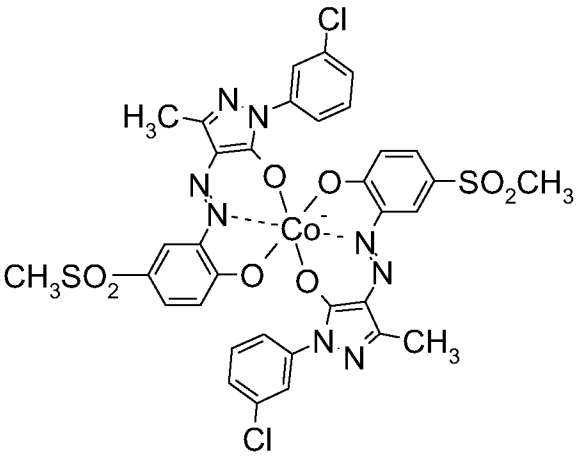
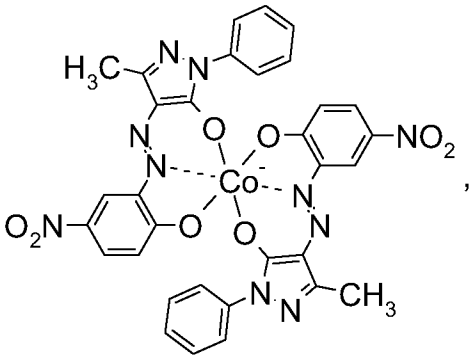
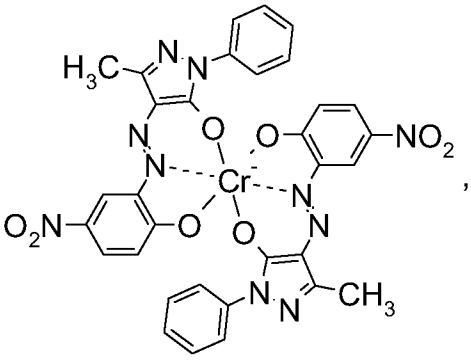
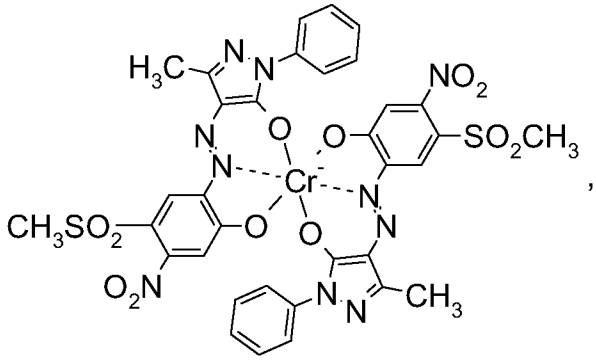
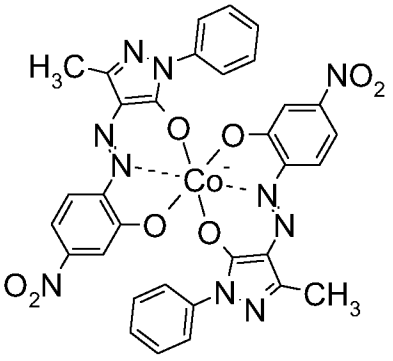
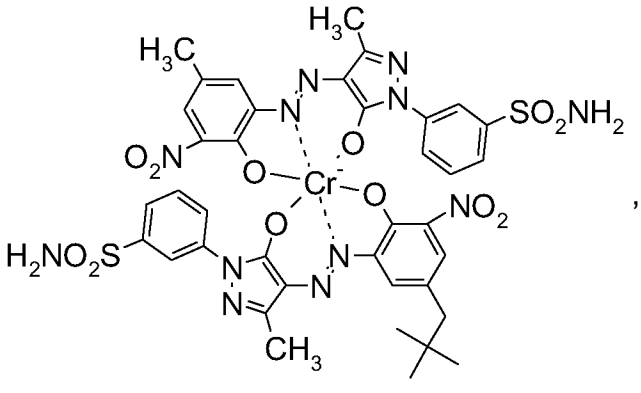
R_{79} is COR_{43}, $COOR_{43}$, $CONR_{64}R_{65}$, CN, $SO_2NR_{64}R_{65}$ or SO_2R_{64};

R_{80}, R_{81}, R_{82} and R_{83} are each independently of the other H, C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51}, NO_2, CN or $COOC_1$-C_4alkyl; and

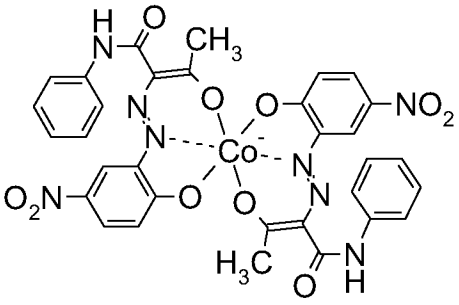
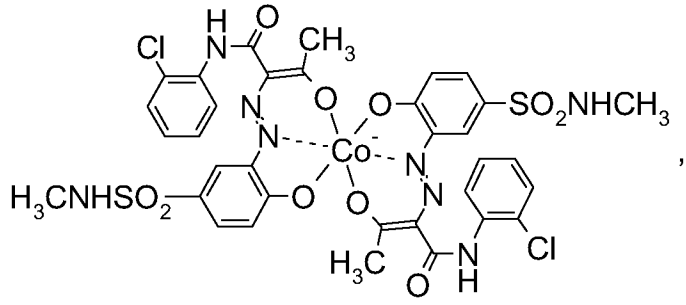
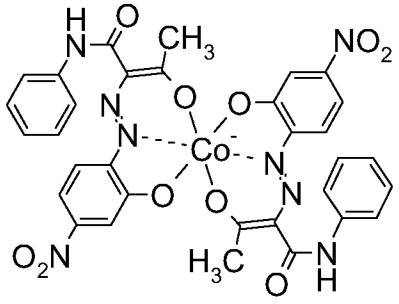
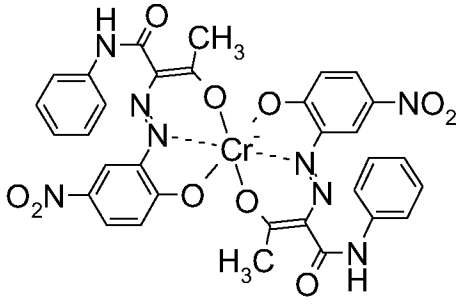
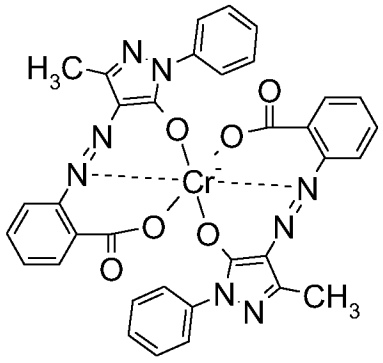
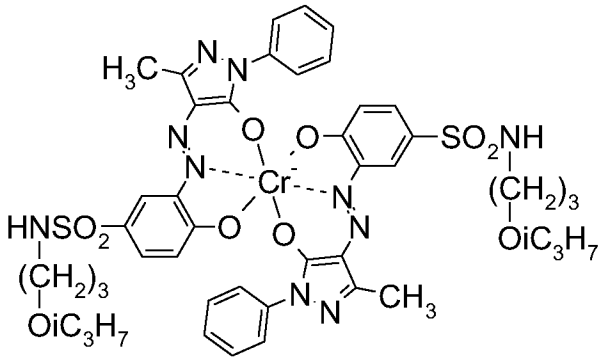
it being possible once or more times radicals of the same or different substituents each selected from the group consisting of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, R_{16}, R_{17}, R_{18}, R_{19}, R_{20}, R_{21}, R_{22}, R_{23}, R_{24}, R_{25}, R_{26}, R_{27}, R_{28}, R_{29}, R_{30}, R_{31}, R_{32}, R_{33}, R_{34}, R_{35}, R_{36}, R_{40}, R_{41}, R_{42}, R_{43}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, R_{49}, R_{50}, R_{51}, R_{53}, R_{55}, R_{56}, R_{57}, R_{58}, R_{59}, R_{62}, R_{63}, R_{64}, R_{66}, R_{67}, R_{68}, R_{69}, R_{70}, R_{71}, R_{72}, R_{77}, R_{79}, R_{80}, R_{81}, R_{82} and R_{83} to be bonded to one another in pairs by way of a direct bond or an -O-, -S- or -N(R_{78})- bridge, optionally forming a compound comprising two or three identical or different moieties of formula (I).

Among the compounds of formula (I), preference is given to those in which anion L_1 and L_2 are identical or different ligands of the formula (b), (c), (d) and (e). In formula (b), R_1 is more preferably an electron withdrawing substituent (such as NO_2, CN, SO_2NH_2, SO_2NHCH_3, SO_2CH_3 or SO_2CF_3) in para position to the oxygen.

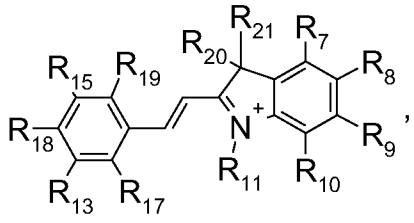
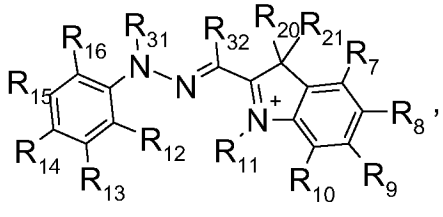
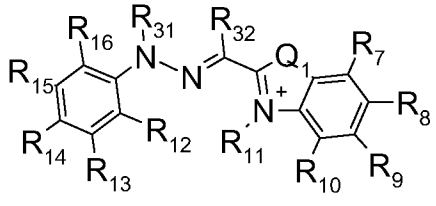
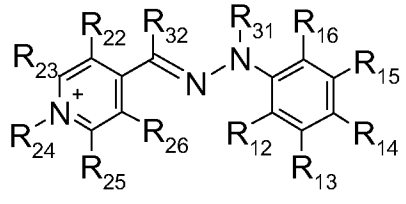
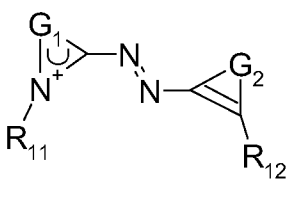
Very particular preference is given to the anions of the formulae


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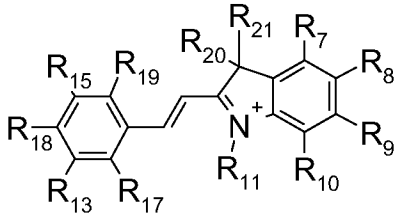
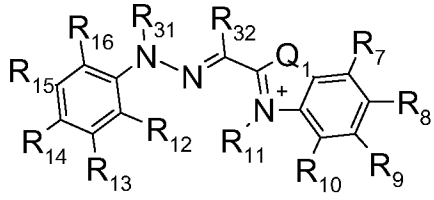
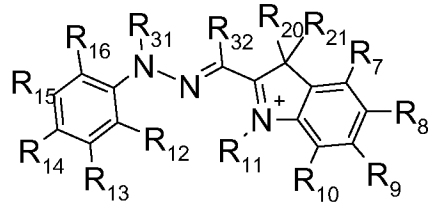

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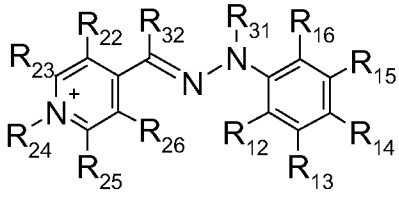
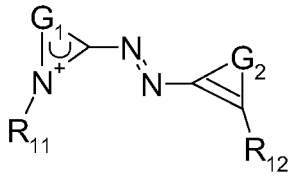
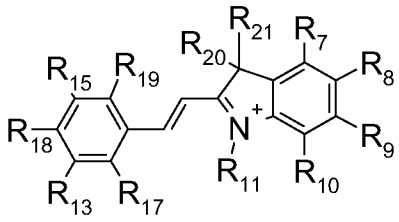
Preferred cations are in particular those of the formulae

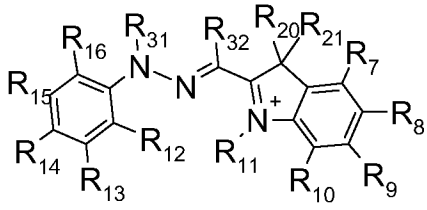
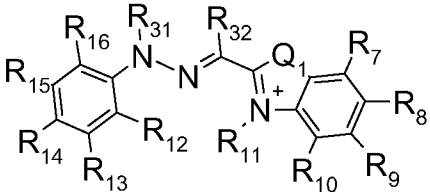
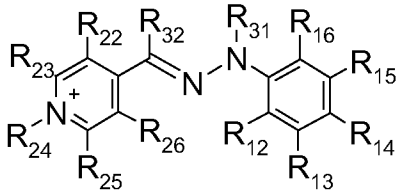

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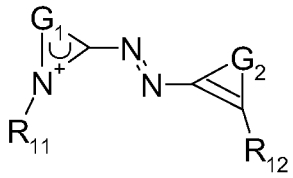
each of which can be combined with each of the above-mentioned anions.

Preferred compounds of formula (I) are those of the formulae

formula	$L_1 = L_2$	M_1	n	cation
(II)	(a)	Co^{3+}	1	
(III)	(a)	Cr^{3+}	1	
(IV)	(b)	Co^{3+}	1	
(V)	(b)	Cr^{3+}	1	
(VI)	(c)	Co^{3+}	1	
(VII)	(c)	Cr^{3+}	1	
(VIII)	(d)	Co^{3+}	1	
(IX)	(d)	Cr^{3+}	1	
(X)	(e)	Co^{3+}	1	
(XI)	(e)	Cr^{3+}	1	
(XII)	(f)	Co^{3+}	1	
(XIII)	(f)	Cr^{3+}	1	
(XIV)	(g)	Co^{3+}	1	
(XV)	(g)	Cr^{3+}	1	
(XVI)	(a)	Co^{3+}	1	
(XVII)	(a)	Cr^{3+}	1	
(XVIII)	(b)	Co^{3+}	1	
(XIX)	(b)	Cr^{3+}	1	
(XX)	(c)	Co^{3+}	1	
(XXI)	(c)	Cr^{3+}	1	
(XXII)	(d)	Co^{3+}	1	
(XXIII)	(d)	Cr^{3+}	1	
(XXIV)	(e)	Co^{3+}	1	
(XXV)	(e)	Cr^{3+}	1	
(XXVI)	(f)	Co^{3+}	1	
(XXVII)	(f)	Cr^{3+}	1	
(XXVIII)	(g)	Co^{3+}	1	
(XXIX)	(g)	Cr^{3+}	1	
(XXX)	(a)	Co^{3+}	1	
(XXXI)	(a)	Cr^{3+}	1	
(XXXII)	(b)	Co^{3+}	1	
(XXXIII)	(b)	Cr^{3+}	1	
(XXXIV)	(c)	Co^{3+}	1	
(XXXV)	(c)	Cr^{3+}	1	
(XXXVI)	(d)	Co^{3+}	1	
(XXXVII)	(d)	Cr^{3+}	1	
(XXXVIII)	(e)	Co^{3+}	1	
(XXXIX)	(e)	Cr^{3+}	1	
(XL)	(f)	Co^{3+}	1	
(XLI)	(f)	Cr^{3+}	1	
(XLII)	(g)	Co^{3+}	1	
(XLIII)	(g)	Cr^{3+}	1	

formula	$L_1 = L_2$	M_1	n	cation
(XLIV)	(a)	Co^{3+}	1	
(XLV)	(a)	Cr^{3+}	1	
(XLVI)	(b)	Co^{3+}	1	
(XLVII)	(b)	Cr^{3+}	1	
(XLVIII)	(c)	Co^{3+}	1	
(XLIX)	(c)	Cr^{3+}	1	
(L)	(d)	Co^{3+}	1	
(LI)	(d)	Cr^{3+}	1	
(LII)	(e)	Co^{3+}	1	
(LIII)	(e)	Cr^{3+}	1	
(LIV)	(f)	Co^{3+}	1	
(LV)	(f)	Cr^{3+}	1	
(LVI)	(g)	Co^{3+}	1	
(LVII)	(g)	Cr^{3+}	1	
(LVIII)	(a)	Co^{3+}	2	
(LIX)	(a)	Cr^{3+}	2	
(LX)	(b)	Co^{3+}	2	
(LXI)	(b)	Cr^{3+}	2	
(LXII)	(c)	Co^{3+}	2	
(LXIII)	(c)	Cr^{3+}	2	
(LXIV)	(d)	Co^{3+}	2	
(LXV)	(d)	Cr^{3+}	2	
(LXVI)	(e)	Co^{3+}	2	
(LXVII)	(e)	Cr^{3+}	2	
(LXVIII)	(f)	Co^{3+}	2	
(LXIX)	(f)	Cr^{3+}	2	
(LXX)	(g)	Co^{3+}	2	
(LXXI)	(g)	Cr^{3+}	2	
(LXXII)	(a)	Co^{3+}	2	 (dimerized)
(LXXIII)	(a)	Cr^{3+}	2	
(LXXIV)	(b)	Co^{3+}	2	
(LXXV)	(b)	Cr^{3+}	2	
(LXXVI)	(c)	Co^{3+}	2	
(LXXVII)	(c)	Cr^{3+}	2	
(LXXVIII)	(d)	Co^{3+}	2	
(LXXIX)	(d)	Cr^{3+}	2	
(LXXX)	(e)	Co^{3+}	2	
(LXXXI)	(e)	Cr^{3+}	2	
(LXXXII)	(f)	Co^{3+}	2	
(LXXXIII)	(f)	Cr^{3+}	2	
(LXXXIV)	(g)	Co^{3+}	2	
(LXXXV)	(g)	Cr^{3+}	2	

formula	$L_1 = L_2$	M_1	n	cation
(LXXXVI)	(a)	Co^{3+}	2	 (dimerized)
(LXXXVII)	(a)	Cr^{3+}	2	
(LXXXVIII)	(b)	Co^{3+}	2	
(LXXXIX)	(b)	Cr^{3+}	2	
(XC)	(c)	Co^{3+}	2	
(XCI)	(c)	Cr^{3+}	2	
(XCII)	(d)	Co^{3+}	2	
(XCIII)	(d)	Cr^{3+}	2	
(XCIV)	(e)	Co^{3+}	2	
(XCV)	(e)	Cr^{3+}	2	
(XCVI)	(f)	Co^{3+}	2	
(XCVII)	(f)	Cr^{3+}	2	
(XCVIII)	(g)	Co^{3+}	2	
(XCIX)	(g)	Cr^{3+}	2	
(C)	(a)	Co^{3+}	2	 (dimerized)
(CI)	(a)	Cr^{3+}	2	
(CII)	(b)	Co^{3+}	2	
(CIII)	(b)	Cr^{3+}	2	
(CIV)	(c)	Co^{3+}	2	
(CV)	(c)	Cr^{3+}	2	
(CVI)	(d)	Co^{3+}	2	
(CVII)	(d)	Cr^{3+}	2	
(CVIII)	(e)	Co^{3+}	2	
(CIX)	(e)	Cr^{3+}	2	
(CX)	(f)	Co^{3+}	2	
(CXI)	(f)	Cr^{3+}	2	
(CXII)	(g)	Co^{3+}	2	
(CXIII)	(g)	Cr^{3+}	2	
(CXIV)	(a)	Co^{3+}	2	 (dimerized)
(CXV)	(a)	Cr^{3+}	2	
(CXVI)	(b)	Co^{3+}	2	
(CXVII)	(b)	Cr^{3+}	2	
(CXVIII)	(c)	Co^{3+}	2	
(CXIX)	(c)	Cr^{3+}	2	
(CXX)	(d)	Co^{3+}	2	
(CXXI)	(d)	Cr^{3+}	2	
(CXXII)	(e)	Co^{3+}	2	
(CXXIII)	(e)	Cr^{3+}	2	
(CXXIV)	(f)	Co^{3+}	2	
(CXXV)	(f)	Cr^{3+}	2	
(CXXVI)	(g)	Co^{3+}	2	
(CXXVII)	(g)	Cr^{3+}	2	

formula	$L_1 = L_2$	M_1	n	cation
(CXXVIII)	(a)	Co^{3+}	2	 (dimerized)
(CXXIX)	(a)	Cr^{3+}	2	
(CXXX)	(b)	Co^{3+}	2	
(CXXXI)	(b)	Cr^{3+}	2	
(CXXXII)	(c)	Co^{3+}	2	
(CXXXIII)	(c)	Cr^{3+}	2	
(CXXXIV)	(d)	Co^{3+}	2	
(CXXXV)	(d)	Cr^{3+}	2	
(CXXXVI)	(e)	Co^{3+}	2	
(CXXXVII)	(e)	Cr^{3+}	2	
(CXXXVIII)	(f)	Co^{3+}	2	
(CXL)	(f)	Cr^{3+}	2	
(CXLI)	(g)	Co^{3+}	2	
(CXLII)	(g)	Cr^{3+}	2	

The anions of the compounds of the formulae (I) are known as salts which can be found, for example, in Ullmanns Encyklopädie der technischen Chemie 23, 381 (4th Edition 1983) or in the Colour Index 4, 4417 (3rd Edition 1971). Some of them are still novel, but they can be prepared in analogy to the known compounds by methods known per se.

The recording laser has more preferably a wavelength of from 370 to 450 nm. Especially preferred is within the UV-A range a wavelength of from 370 to 390 nm, especially approximately 380 nm, or especially at the edge of the visible range of from 390 to 430 nm, more preferably approximately 405 ± 5 nm.

The UV-A range is from 315 to 400 nm, the visible range from 400 to 700 nm. The absorption maximum of the iodide salt of the cation Z_1 is preferably at a wavelength of up to 545 nm, more preferably from 350 to 520 nm, especially from 420 to 520 nm. The 315 to 700 nm spectrum is most adequately measured at a concentration of $2 \cdot 10^{-4}$ mol/l in ethanol, or alternatively in dichloromethane if the solubility in ethanol is insufficient, or in N,N-dimethylformamide if the solubilities in both ethanol and dichloromethane are insufficient.

Substituents, including a plurality of substituents having the same label, are generally independent from each other. Preferred are compounds of formula (I),

wherein n is 1, as well as alternatively compounds of formula (I), wherein n is 2 and Z_1^{n+} consists of two identical or different cations Z_1^+ linked together by way of a direct bond or an -O-, -S- or -N(R_{78})- bridge (further explanations given below).

M_1 is a cation in the oxidation state +3, a hydroxy or halogen metal cation wherein the metal is in the oxidation state +4, or an oxo metal cation wherein the metal is in the oxidation state +5, of an at least trivalent metal of groups 3 to 15 (formerly groups IIIA to VB), preferably Al^{3+}, As^{3+}, Au^{3+}, Bi^{3+}, Ce^{3+}, Co^{3+}, Cr^{3+}, Dy^{3+}, Er^{3+}, Eu^{3+}, Fe^{3+}, Gd^{3+}, Ho^{3+}, Ir^{3+}, La^{3+}, Lu^{3+}, Mn^{3+}, Mo^{3+}, Nb^{3+}, Nd^{3+}, Pm^{3+}, Pr^{3+}, Rh^{3+}, Ru^{3+}, Sb^{3+}, Sc^{3+}, Sm^{3+}, Ta^{3+}, Tb^{3+}, Ti^{3+}, $[TiCl]^{3+}$, $[TiOH]^{3+}$, Tm^{3+}, V^{3+}, $[VO]^{3+}$, W^{3+}, Y^{3+}, Yb^{3+}, $[ZrCl]^{3+}$ or $[ZrOH]^{3+}$, most preferred Co^{3+} or Cr^{3+}.

Alkyl, alkenyl or alkynyl may be straight-chain or branched. Alkenyl is alkyl that is mono- or poly-unsaturated, wherein two or more double bonds may be isolated or conjugated. Alkynyl is alkyl or alkenyl that is doubly-unsaturated one or more times, wherein the triple bonds may be isolated or conjugated with one another or with double bonds. Cycloalkyl or cycloalkenyl is monocyclic or polycyclic alkyl or alkenyl, respectively.

C_1-C_{12}Alkyl can therefore be, for example, methyl, ethyl, n-propyl, isopropyl, n-butyl, sec-butyl, isobutyl, tert-butyl, 2-methyl-butyl, n-pentyl, 2-pentyl, 3-pentyl, 2,2-dimethylpropyl, n-hexyl, heptyl, n-octyl, 1,1,3,3-tetramethylbutyl, 2-ethylhexyl, nonyl, decyl, undecyl or dodecyl.

C_3-C_{12}Cycloalkyl can therefore be, for example, cyclopropyl, cyclopropyl-methyl, cyclobutyl, cyclopentyl, cyclohexyl, cyclohexyl-methyl, trimethylcyclohexyl, thujyl, norbornyl, bornyl, norcaryl, caryl, menthyl, norpinyl, pinyl, 1-adamantyl or 2-adamantyl.

C_2-C_{12}Alkenyl is, for example, vinyl, allyl, 2-propen-2-yl, 2-buten-1-yl, 3-buten-1-yl, 1,3-butadien-2-yl, 2-penten-1-yl, 3-penten-2-yl, 2-methyl-1-buten-3-yl, 2-methyl-3-buten-2-yl, 3-methyl-2-buten-1-yl, 1,4-pentadien-3-yl, or any isomer of hexenyl, octenyl, nonenyl, decenyl or dodecenyl.

C_3-C_{12}Cycloalkenyl is, for example, 2-cyclobuten-1-yl, 2-cyclopenten-1-yl, 2-cyclohexen-1-yl, 3-cyclohexen-1-yl, 2,4-cyclohexadien-1-yl, 1-*p*-menthen-8-yl, 4(10)-thujen-10-yl, 2-norbornen-1-yl, 2,5-norbornadien-1-yl, 7,7-dimethyl-2,4-norcaradien-3-yl or camphenyl.

C_2-C_{12}Alkynyl is, for example, 1-propyn-3-yl, 1-butyn-4-yl, 1-pentyn-5-yl, 2-methyl-3-butyn-2-yl, 1,4-pentadiyn-3-yl, 1,3-pentadiyn-5-yl, 1-hexyn-6-yl, cis-3-methyl-2-penten-4-yn-1-yl, trans-3-methyl-2-penten-4-yn-1-yl, 1,3-hexadiyn-5-yl, 1-octyn-8-yl, 1-nonyn-9-yl, 1-decyn-10-yl or 1-dodecyn-12-yl.

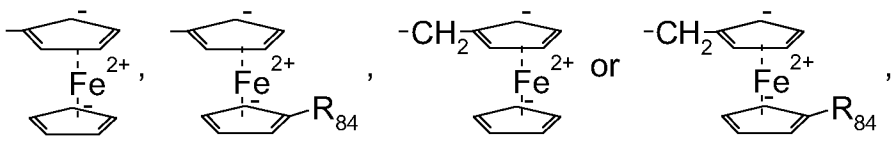
C_7-C_{12}Aralkyl is, for example, benzyl, 2-benzyl-2-propyl, β-phenyl-ethyl, 9-fluorenyl, α,α-dimethylbenzyl, ω-phenyl-butyl, ω-phenyl-octyl, ω-phenyl-dodecyl or 3-methyl-5-(1',1',3',3'-tetramethyl-butyl)-benzyl. When C_7-C_{12}aralkyl is substituted, both the alkyl moiety and the aryl moiety of the aralkyl group can be substituted, the latter alternative being preferred.

C_6-C_{12}Aryl is, for example, phenyl, naphthyl or biphenyl, always preferred phenyl.

Halogen is chlorine, bromine, fluorine or iodine, preferably chlorine or bromine on aryl or heteroaryl and fluorine on alkyl.

C_1-C_9Heteroaryl is an unsaturated or aromatic radical having 4n+2 conjugated π-electrons, for example 2-thienyl, 2-furyl, 1-pyrazolyl, 2-pyridyl, 2-thiazolyl, 2-oxazolyl, 2-imidazolyl, isothiazolyl, triazolyl, tetrazolyl or any other ring system consisting of thiophene, furan, thiazole, oxazole, imidazole, isothiazole, thiadiazole, triazole, pyridine, pyrazine, pyrimidine, pyridazine and benzene rings and unsubstituted or substituted by from 1 to 6 substituents, for example methyl, ethyl, ethylene and/or methylene substituents.

Furthermore, aryl and aralkyl can also be aromatic groups bonded to a metal, for example in the form of metallocenes of transition metals known *per se*, more

especially 

wherein R_{84} is CH_2OH, CH_2OR_{43} or $COOR_{43}$.

C_3-C_{12}Heterocycloalkyl is an unsaturated or partially unsaturated ring system radical, for example epoxy, oxetan, aziridine; tetrazolyl, pyrrolidyl, piperidyl, piperazinyl, imidazolinyl, pyrazolidinyl, pyrazolinyl, morpholinyl, quinuclidinyl; or some other C_4-C_{12}heteroaryl that is mono- or poly-hydrogenated.

5- to 12-membered rings are, for example, cyclopentyl, cyclohexyl, cycloheptyl and cyclooctyl, preferably cyclopentyl and especially cyclohexyl.

Preferably, in the heterocycle comprising G_1, R_{54} is H, or together with R_{44} is butadienylen either unsubstituted or substituted, preferably unsubstituted or substituted by one or more C_1-C_4alkyl, halogen, OR_{62}, SR_{62}, $NR_{61}R_{63}$, CF_3, NO_2, CN, COR_{63}, $COOR_{62}$, SO_2R_{63} and/or SO_3R_{62}.

Preferably, each R_{62} is independently of any other R_{62} alkyl or H, and each R_{56} is independently of any other R_{56} hydrogen or C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl, C_2-C_5heterocycloalkyl or C_7-C_{11}aralkyl each unsubstituted or mono- or poly-substituted by OR_{66}, SR_{66}, $NR_{61}R_{63}$ and/or $COOR_{63}$.

The number n is preferably 1 or 2.

The preferences for the cationic and anionic sub-structures contained in formula (I) are independent of each other. However, it is preferable to combine preferred cations with preferred anions.

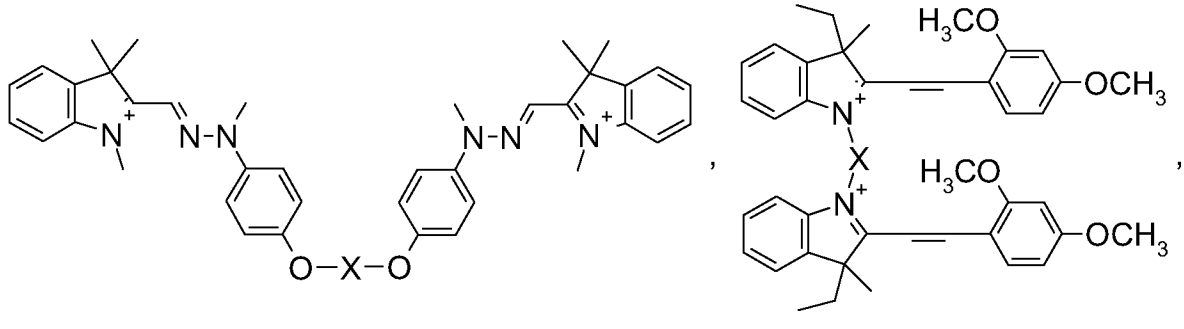
Further preference, which is fully applicable in combination with any or all of above-mentioned preferences, is given to compounds of formula (I) wherein R_{43} and/or R_{63} are methyl, ethyl, n-propyl, isopropyl, n-butyl, 2-butyl, isobutyl, tert-butyl, 3-pentyl, n-amyl, tert-amyl, neopentyl, 2,2-dimethyl-but-4-yl, cyclopropyl, cyclopropylmethyl, cyclobutyl, cyclobutylmethyl, cyclopentyl, cyclopentylmethyl or

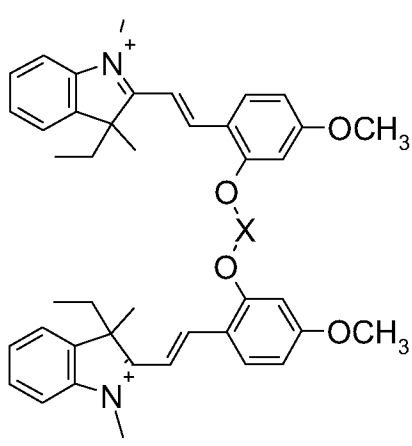
cyclohexyl, each unsubstituted or mono- or poly-substituted by fluorine. R_{53} and R_{54} are preferably both methyl, both ethyl or R_{53} ethyl and R_{54} methyl, or both together 1,5-pentylen. Alkyl, alkenyl, alkynyl, cycloalkyl and heterocycloalkyl are generally preferably C_1-C_4alkyl, C_2-C_4alkenyl, C_2-C_4alkynyl and epoxyalkyl, respectively. All these further preferences are fully applicable with particular benefits in the case of preferred R_{56} and/or R_{62} and/or n, too.

When R_{61}, R_{63}, R_{67} and R_{68} are bonded to one another in pairs by way of a direct bond or an -O-, -S- or -NR_{78}- bridge, they are preferably so bonded that a five- or six-membered ring is formed.

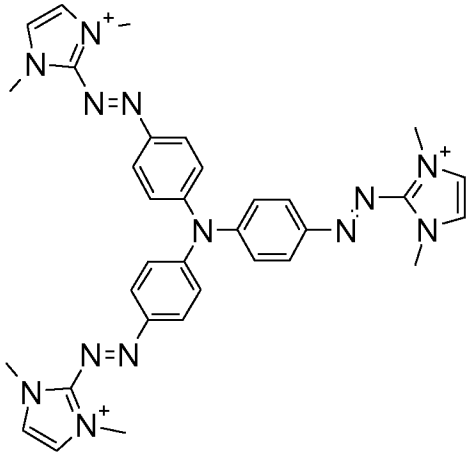
Another aspect of the invention are compounds of formula (I) wherein two cations or two ligands of the anion are bridged, for example by way of direct bonds or -O-, -S- or -NR_{78}- bridges between any substituents in formula (I), it being possible for the bridged ligands to be complexed either with the same metal cation or optionally with different metal cations, there being formed in the latter case oligomers which are, of course, also to be regarded as being subjects of the invention. Bridgings by way of O or N atoms of the cation or anion, either those in the chromophore or those on substituents, are especially advantageous.

Compounds comprising 2 or 3 different moieties of formula (I) linked together by bonds and/or bridges may be either symmetrical or preferably asymmetrical and can be made purposefully in close analogy to methods which are known *per se*. In the following illustrative, "dimerized" or "trimerized" examples (which are on no account limiting), X may be, for example, -$(CH_2)_2$-, -$(CH_2)_3$-, -$(CH_2)_4$-, -$(CH_2)_6$-, -$(CH_2)_2$-O-$(CH_2)_2$-, -$(CH_2)_2$-NH-$(CH_2)_2$-, -CH_2-$C(CH_3)_2$-CH_2- or -CH_2-pC_6H_4-CH_2- :



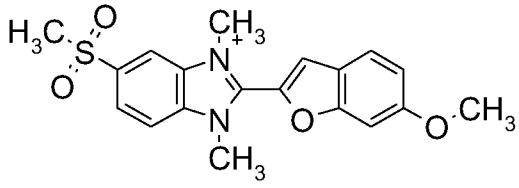


or

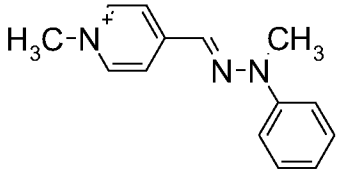


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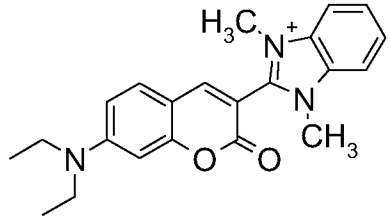
Particularly useful cations of formula (I) are those of the following formulae (λ_{max} of iodide salts in ethanol):



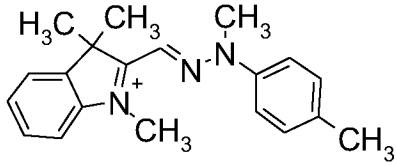
(366 nm),



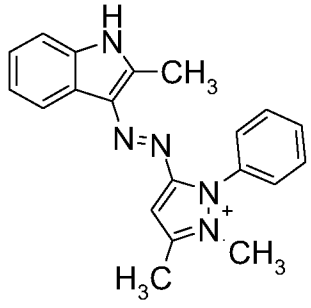
(418 nm),



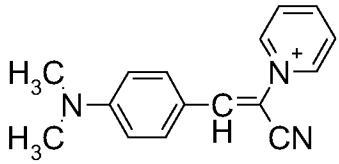
(438 nm),



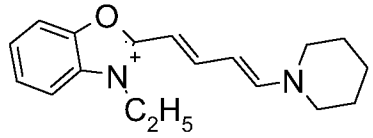
(438 nm),



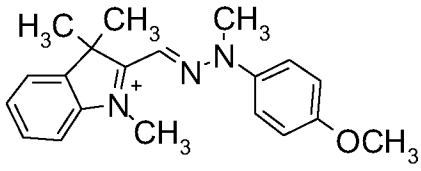
(440 nm),



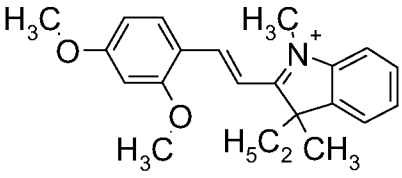
(446 nm),



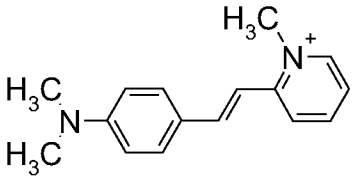
(449 nm),



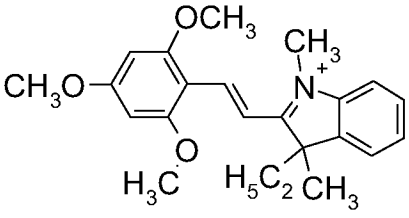
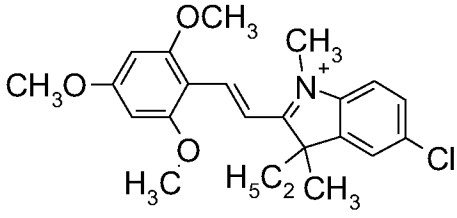
(449 nm),

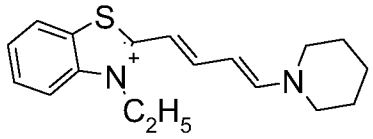
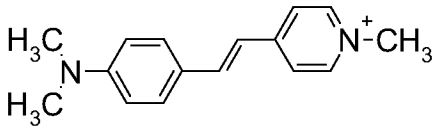


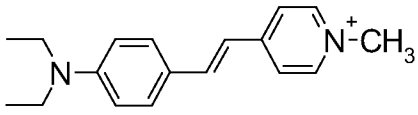
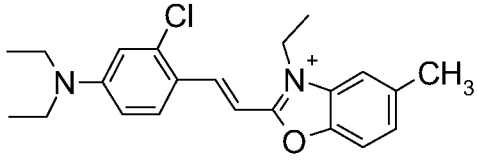
(462 nm),

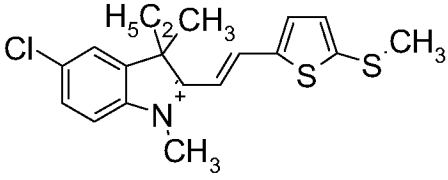
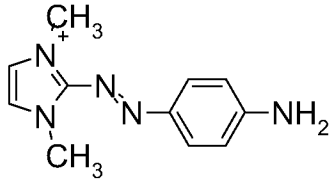


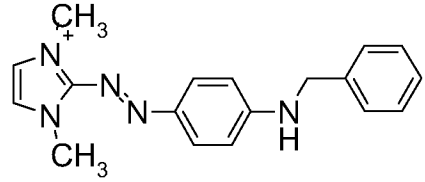
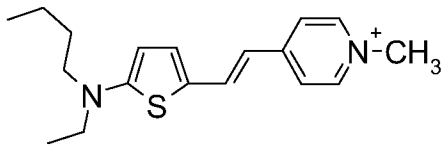
(466 nm),

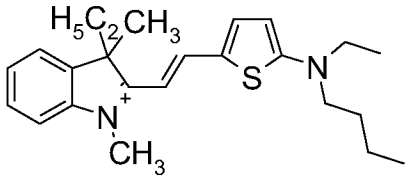
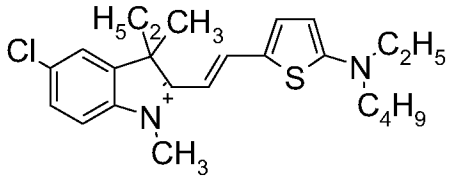

(468 nm),

(470 nm),

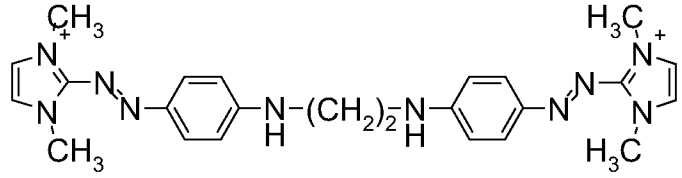

(487 nm),

(491 nm),


(492 nm),

(499 nm),


(506 nm),

(507 nm),


(516 nm),

(548 nm) ,


(560 nm),

(570 nm)

and

(542 nm).

Many of the instant anions and cations are known. The anions and cations as well as the novel salts of formula (I) can be prepared according to or in close analogy to known methods, or according or in analogy to the examples given below. Less common ones of the preferred cations can for example be prepared according to Tetrahedron 42, 699 [1986] or J. Am. Chem. Soc. 63, 3192 [1941]. For the formation of the salts of formula (I), generally in a hydrophilic solvent, the anions

are conveniently used as ammonium or alcali metal salts, and the cations as acetate, halogenide, perchlorate, hexafluorophosphate or tetrafluoroborate salts.

The compounds of formula (I) are new. Hence, the invention also relates to a compound of formula (I), as well as to a process for the preparation of a thin layer on a substrate, wherein a solution of a compound of formula (I) in a volatile solvent is applied onto the rotating substrate and the solvent is then evaporated.The solution comprises preferably from 0.1 to 20% of a compound of formula (I) in a solvent (preferably an organic solvent) having a boiling point of from 0 to 180°C, more preferably from 50 to 150°C, at 1 bar pressure.

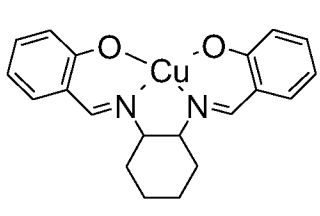
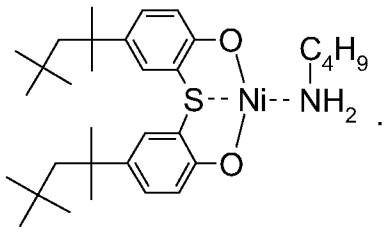
The invention also pertains to the use of a compound of formula (I) for the preparation of a medium for optical recording with a laser of wavelength below 600 nm, preferably from 350 to 500 nm, especially from 350 to 450 nm, and to a process for the optical recording or playback of information, wherein a laser beam of wavelength below 600 nm, preferably from 350 to 500 nm, especially from 350 to 450 nm, is focussed onto the recording track of a recording medium comprising a compound of formula (I).

The recording layer advantageously comprises a compound of formula (I) or a mixture of such compounds as main component, for example at least 50% by weight, preferably at least 80% by weight, especially at least 90% by weight. Further customary constituents are possible, for example other chromophores (for example those disclosed in WO 01/75873, or others having an absorption maximum at from 300 to 1000 nm), stabilisers, $^1O_2$-, triplet- or luminescence-quenchers, melting-point reducers, decomposition accelerators or any other additives that have already been described in optical recording media. Preferably, stabilisers or fluoresence-quenchers are added if desired.

When the recording layer comprises further chromophores, the amount of such chromophores should preferably be small, so that the absorption thereof at the wavelength of the inversion point of the shortest-wavelength flank of the absorption of the entire solid layer is a fraction of the absorption of the pure compound of

formula (I) in the entire solid layer at the same wavelength, advantageously at most 1/3, preferably at most 1/5, especially at most 1/10. The absorption maximum is preferably higher than 425 nm, especially higher than 460 nm.

Stabilisers, $^1O_2$-, triplet- or luminescence-quenchers are, for example, metal complexes of N- or S-containing enolates, phenolates, bisphenolates, thiolates or bisthiolates or of azo, azomethine or formazan dyes, such as bis(4-dimethylamino-dithiobenzil)nickel [CAS Nº 38465-55-3], ®Irgalan Bordeaux EL, ®Cibafast N or similar compounds, hindered phenols and derivatives thereof, such as ®Cibafast AO, o-hydroxyphenyl-triazoles or -triazines or other UV absorbers, such as ®Cibafast W or ®Cibafast P or hindered amines (TEMPO or HALS, also as nitroxides or NOR-HALS), and also diimmonium salts, Paraquat™ or Orthoquat™ salts, such as ®Kayasorb IRG 022, ®Kayasorb IRG 040, optionally also as radical ion salts, such as N,N,N',N'-tetrakis(4-dibutylaminophenyl)-p-phenyleneamine-ammonium hexafluorophosphate, hexafluoroantimonate or perchlorate. The latter are available from Organica (Wolfen / DE); ®Kayasorb brands are available from Nippon Kayaku Co. Ltd., and ®Irgalan and ®Cibafast brands are available from Ciba Specialty Chemicals Inc.

Many such structures are known, some of them also in connection with optical recording media, for example from US-5 219 707, JP-A-06/199045, JP-A-07/76169, JP-A-07/262604 or JP-A-2000/272241. They may be, for example, salts of the metal complex anions disclosed above with any desired cations, for example the cations disclosed above, or metal complexes, illustrated, for example, by a compound of formula  or  .

The person skilled in the art will know from other optical information media, or will easily identify, which additives in which concentration are particularly well suited to which purpose. Suitable concentrations of additives are, for example, from 0.001 to

100% by weight, preferably from 1 to 50% by weight, based on the recording medium of formula (I).

The optical recording materials according to the invention exhibit excellent spectral properties of the solid amorphous recording layer. The aggregation tendency in the solid is surprisingly low for such compounds. Crystallites are unexpectedly and very advantageously not formed or are formed only to a negligible extent. The reflectivity of the layers in the range of the writing and reading wavelength is suitable for both low to high and high to low systems.

By virtue of those excellent layer properties it is possible to obtain a rapid optical recording having high sensitivity, high reproducibility and geometrically very precise mark boundaries - also for very short (2T) marks -, the complex refractive index and the reflectivity changing substantially, which gives a high degree of contrast. The differences in the mark lengths and the interval distances ("jitter") are very small, which enables a high storage density to be obtained using a relatively thin recording channel with a narrow track spacing ("pitch"). The dye layer quality is excellent, leading to high signal-to-noise ratio (CNR, PRSNR) and astonishingly low error rate (SbER) upon play-back.

By virtue of the excellent solubility, including in apolar solvents, solutions can be used even in high concentrations without troublesome precipitation, for example during storage, so that problems during spin-coating are largely eliminated. This applies especially to compounds containing branched C_3-C_8alkyl.

Recording and playback can take place at the same wavelength, therefore advantageously requiring a simple optical system with a single laser source of advantageously from 350 to 500 nm, preferably from 370 to 450 nm. Especially preferred is the UV range from 370 to 390 nm, especially approximately 380 nm, or especially at the edge of the visible range of from 390 to 430 nm, more especially approximately 405 ± 5 nm. In the field of compact, blue or violet laser diodes (such as Nichia GaN 405 nm) with an optical system of high numerical aperture, the marks can be so small and the tracks so narrow that up to about 20 to 25 Gb per

recording layer is achievable on a 120 mm disc. At 380 nm it is possible to use indium-doped UV-VCSELs (Vertical-Cavity Surface-Emitting Laser), which laser source already exists as a prototype [Jung Han *et al.*, see MRS Internet J. Nitride Semicond. Res. 5S1, W6.2 (2000)].

The invention therefore relates also to a method of recording or playing back data, wherein the data on an optical recording medium according to the invention are recorded or played back at a wavelength of below 600 nm, preferably from 350 to 500 nm.

The recording medium is based on the structure of known recording media and is, for example, analogous to those mentioned above. It may be composed, for example, of a transparent substrate, a recording layer comprising at least one of the compounds of formula (I), a reflector layer and a covering layer, the writing and readout being effected through the substrate.

Suitable substrates are, for example, glass, minerals, ceramics and thermosetting and thermoplastic plastics. Preferred supports are glass and homo- or co-polymeric plastics. Suitable plastics are, for example, thermoplastic polycarbonates, polyamides, polyesters, polyacrylates and polymethacrylates, polyurethanes, polyolefins, polyvinyl chloride, polyvinylidene fluoride, polyimides, thermosetting polyesters and epoxy resins. Special preference is given to polycarbonate substrates which can be produced, for example, by injection-moulding. The substrate can be in pure form or may comprise customary additives, for example UV absorbers or dyes, as proposed e.g. in JP-A-04/167239 as light stabilisation for the recording layer. In the latter case it may be that in the range of the writing wavelength (emission wavelength of the laser) the dye added to the support substrate has no or at most only very low absorption, preferably up to a maximum of about 20% of the laser light focussed onto the recording layer.

The substrate is advantageously transparent over at least a portion of the range from 350 to 500 nm, so that it is permeable to, for example, at least 80% of the incident light of the writing or readout wavelength. The substrate is advantageously

from 10 μm to 2 mm thick, preferably from 100 to 1200 μm thick, especially from 600 to 1100 μm thick, with a preferably spiral guide groove (track) on the coating side, a groove depth of from 10 to 200 nm, preferably from 20 to 90 nm, a groove width of from 100 to 400 nm, preferably from 150 to 250 nm, and a spacing between two turns of from 200 to 600 nm, preferably from 300 to 450 nm. Grooves of different cross-sectional shape are known, for example rectangular, trapezoidal or V-shaped. Analogously to the known CD-R and DVD-R media, the guide groove may additionally undergo a small periodic or quasi-periodic lateral deflection (wobble), so that synchronisation of the speed of rotation and the absolute positioning of the reading head (pick-up) are made possible. Instead of, or in addition to, the deflection, the same function can be performed by markings between adjacent grooves (pre-pits). With such geometry, it is advantageously possible to meet the HD DVD™ specifications.

The recording medium is applied, for example, by application of a solution by spin-coating, the objective being to produce a layer that is as amorphous as possible, the thickness of which layer is advantageously from 0 to 60 nm, preferably from 10 to 55 nm, especially from 20 to 50 nm, on the surface ("land") and, depending upon the geometry of the groove, advantageously from 20 to 150 nm, preferably from 30 to 100 nm, especially from 40 to 80 nm, in the groove.

Reflecting materials suitable for the reflector layer include especially metals, which provide good reflection of the laser radiation used for recording and playback, for example the metals of Main Groups 13 – 15 and of the Sub-Groups 3 – 12 of the Periodic Table of the Elements. Al, In, Sn, Pb, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, La, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt and the lanthanide metals Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu and alloys thereof are especially suitable. On account of its high reflectivity and ease of production special preference is given to a reflective layer of aluminium, silver, gold or an alloy thereof (for example a white gold alloy), especially aluminium on economic and ecological grounds. The reflector layer is advantageously from 5 to 200 nm thick, preferably from 10 to 150 nm thick, especially from 50 to 120 nm

thick, but reflector layers of greater thickness, for example 1 mm thick or even more, are also possible.

Materials suitable for the covering layer include chiefly plastics, which are applied in a thin layer to the reflector layer either directly or with the aid of adhesion promoters. It is advantageous to select mechanically and thermally stable plastics having good surface properties, which can be modified further, for example written on. The plastics may be thermosetting plastics and thermoplastic plastics. Directly applied covering layers are preferably radiation-cured (e.g. using UV radiation) coatings, which are particularly simple and economical to produce. A wide variety of radiation-curable materials are known. Examples of radiation-curable monomers and oligomers are acrylates and methacrylates of diols, triols and tetrols, polyimides of aromatic tetracarboxylic acids and aromatic diamines having C_1-C_4alkyl groups in at least two ortho-positions of the amino groups, and oligomers with dialkylmaleinimidyl groups, e.g. dimethylmaleinimidyl groups. For covering layers that are applied using adhesion promoters it is preferable to use the same materials as those used for the substrate layer, especially polycarbonates. The adhesion promoters used are preferably likewise radiation-curable monomers and oligomers. Instead of the covering layer applied using an adhesion promoter there may also be used a second substrate comprising a recording and reflector layer, so that the recording medium is playable on both sides. Preference is given to a symmetrical structure, the two parts being joined together at the reflector side by an adhesion promoter directly or by way of an intermediate layer.

In such a structure, the optical properties of the covering layer, or the covering materials, are essentially unimportant *per se* provided that, where applicable, curing thereof e.g. by UV radiation is achieved. The function of the covering layer is to ensure the mechanical strength of the recording medium as a whole and, if necessary, the mechanical strength of thin reflector layers. If the recording medium is sufficiently robust, for example when a thick reflector layer is present, it is even possible to dispense with the covering layer altogether. The thickness of the covering layer depends upon the thickness of the recording medium as a whole,

which should preferably be a maximum of about 2 mm thick. The covering layer is preferably from 10 μm to 1 mm thick.

The recording media according to the invention may also have additional layers, for example interference layers or barrier layers. The structure and the use of such materials are known to the person skilled in the art. Where present, interference layers are preferably arranged between the recording layer and the reflecting layer and/or between the recording layer and the substrate and consist of a dielectric material, for example as described in EP-A-0 353 393 of TiO_2, Si_3N_4, ZnS or silicone resins.

It is also possible to construct recording media having a plurality of recording layers (for example 2, 3, 4, 5, 6, 7, 8, 9 or 10). In particular, a dual layer disk where both recording layers can be recorded and read from the same side can be used: for example Dual Layer HD DVD-R™ featuring 30 GB/side. The instant compounds can be in one or more of the layers, for example in layer (L0), in layer (L1) or in both layers (L0) and (L1) of a Dual Layer disk.

One way to manufacture such multilayer media called “2P Process” uses the following embodiment: transparent substrate / recording material / semi-reflective layer / spacer layer applied by spin-coating and cured through a transparent stamper / second recording layer / reflective layer / adhesive layer / second half disk. Intermediate protective layers can be introduced when required.

Another way to manufacture dual layer media called “inverted stack” or “reversed stack” consists of making on one hand a half-disk with the following embodiment: transparent substrate / recording layer / semi-reflective layer and on the other hand another half-disk with an inverted layer sequence: substrate / reflective layer / recording layer. The two half-disks are then bonded together with an adhesive layer so that the two substrates form the two sides of the final disk. Intermediate protective layers can be introduced at various places when required, for example between the recording material and the adhesive layer. Such technique is described for example in WO 04/021 336 and in WO 04/042 717. The groove geometries and

layer thicknesses are essentially in the same range as described above, with the difference for the inverted stack half disk that recording is made on-groove. The thickness of the recording layer in the latter case is advantageously from 20 to 150 nm, preferably from 30 to 100 nm, especially from 40 to 80 nm on the groove, and, depending upon the geometry of the groove, advantageously from 30 to 200 nm, preferably from 40 to 150 nm, especially from 50 to 100 nm, in the groove.

Hence, the invention also pertains to an optical recording medium suitable for optical recording with a laser of wavelength below 600 nm, preferably from 350 to 500 nm, comprising a grooved substrate, a reflecting layer and at least two recording tracks, wherein at least one recording track comprises a compound of formula $[(L_1)M_1(L_2)]^{m-}\ Z_1^{n+}$ (I), or a mesomeric or tautomeric form thereof.

The recording media according to the invention can be produced by processes known *per se*, it being possible for various methods of coating to be employed depending upon the materials used and their function.

Suitable coating methods are, for example, immersion, pouring, brush-coating, blade-application and spin-coating, as well as vapour-deposition methods carried out under a high vacuum. When, for example, pouring methods are used, solutions in organic solvents are generally employed. When solvents are employed, care should be taken that the supports used are insensitive to those solvents. Suitable coating methods and solvents are described, for example, in EP-A-0 401 791.

The recording layer is applied preferably by the application of a dye solution by spin-coating, solvents that have proved satisfactory being especially alcohols, e.g. 2-methoxyethanol, isopropanol or n-butanol, hydroxyketones, for example diacetone alcohol or 3-hydroxy-3-methyl-2-butanone, hydroxy esters, for example lactic acid methyl ester or isobutyric acid methyl ester, or preferably fluorinated alcohols, for example 2,2,2-trifluoroethanol or 2,2,3,3-tetrafluoro-1-propanol, and mixtures thereof. Further suitable solvents are well-known in the art and disclosed, for example, in EP-A-0 483 387.

The application of the metallic reflector layer is preferably effected by sputtering or by vapour-deposition *in vacuo*. Such techniques are known and are described in specialist literature (e.g. J. L. Vossen and W. Kern, "Thin Film Processes", Academic Press, 1978). The operation can advantageously be carried out continuously and achieves good reflectivity and a high degree of adhesiveness of the metallic reflector layer.

Recording is carried out in accordance with known methods by writing pits (marks) of fixed or variable length by means of a modulated, focussed laser beam guided at a constant or variable speed over the surface of the recording layer. Readout of information is carried out according to methods known *per se* by registering the change in reflection using laser radiation, for example as described in "CD-Player und R-DAT Recorder" (Claus Biaesch-Wiepke, Vogel Buchverlag, Würzburg 1992). The person skilled in the art will be familiar with the requirements.

The information-containing medium according to the invention may be an optical information material of the WORM type. It can be used, for example, analogously to CD-R (compact disc - recordable) or DVD-R (digital video disc – recordable) in computers, and also as storage material for identification and security cards or for the production of diffractive optical elements, for example holograms.

Alternatively, however, there are also recording media which differ substantially from CD-R and DVD-R and in which recording and playback take place not through the substrate but through the covering layer (in-groove or on-groove recording). Accordingly, the respective roles of the covering layer and the substrate, especially the geometry and the optical properties, are reversed in comparison with the structure described above. Analogous concepts are described a number of times in Proceedings SPIE-Int. Soc. Opt. Eng. 1999, 3864 for digital video recordings in conjunction with a blue GaN laser diode. For such recording media, which are especially suitable for a high storage density and have correspondingly small marks ("pits"), precise focussing is important, so that the manufacturing process, while essentially analogous, is considerably more awkward.

The compounds of formula (I) according to the invention, however, also meet the increased demands of an inverse layer structure surprisingly well. Preference is therefore given to an inverse layer structure having the layer sequence substrate, reflector layer, recording layer and covering layer. The recording layer is therefore located between the reflector layer and the covering layer. A thin covering layer approximately from 50 to 400 μm in thickness is especially advantageous (typically 100 μm for recording and reading with a numerical aperture of 0.85).

The recording and reflector layers in an inverse layer structure have in principle the same functions as indicated above. As with the groove geometry, they therefore usually have dimensions within the ranges indicated above.

The inverse layer structure requires particularly high standards, which the compounds used according to the invention fulfil astonishingly well, for example when the recording layer is applied to the metallic reflector layer and especially when a covering layer is applied to the recording layer, the covering layer being required to provide the recording layer with adequate protection against rubbing, photo-oxidation, fingerprints, moisture and other environmental effects and advantageously having a thickness in the range of from 0.01 to 0.5 mm, preferably in the range of from 0.05 to 0.2 mm, especially in the range of from 0.08 to 0.13 mm.

The covering layer preferably consists of a material that exhibits a transmission of 80% or above at the writing or readout wavelength of the laser. Suitable materials for the covering layer include, for example, those materials mentioned above, but especially polycarbonate (such as Pure Ace® or Panlite®, Teijin Ltd), cellulose triacetate (such as Fujitac®, Fuji Photo Film) or polyethylene terephthalate (such as Lumirror®, Toray Industry), special preference being given to polycarbonate. Especially in the case of directly applied covering layers, radiation-cured coatings, such as those already described above, are advantageous, for example SD 347™ (Dainippon Ink).

The covering layer can be applied directly to the solid recording layer by means of

a suitable adhesion promoter. In another embodiment, there is applied to the solid recording layer an additional, thin separating layer of a metallic, crosslinked organometallic or preferably dielectric inorganic material, for example in a thickness of from 0.001 to 10 μm, preferably from 0.005 to 1 μm, especially from 0.01 to 0.1 μm, for example from 0.05 to 0.08 μm in the case of dielectric separating layers and from 0.001 to 0.02 μm in the case of metallic separating layers. Separating layers and corresponding methods are disclosed in WO 02/082 438, to which reference is expressly made here. If desired, such coatings can be applied, for example, in the same thickness also between the support material and the metallic reflector layer or between the metallic reflector layer and the optical recording layer. This may be advantageous in certain cases, for example when a silver reflector is used in combination with sulfur-containing additives in the recording layer.

In a special embodiment, there is applied to the solid recording layer an additional, thin separating layer of a metallic, crosslinked organometallic or dielectric inorganic material, for example in a thickness of from 0.001 to 10 μm, preferably from 0.005 to 1 μm, especially from 0.01 to 0.1 μm. On account of their high reflectivity, metallic separating layers should advantageously be a maximum of 0.02 μm thick. Separating layers and corresponding methods are disclosed in WO 02/082 438, to which reference is expressly made here.

In addition to comprising one or more compounds of formula (I) and optionally customary additives, the optical recording media according to the invention may also comprise other chromophores, preferably metal-free chromophores. Other chromophores may, if desired, be added in an amount of from 1 to 200% by weight, based on the total of the compounds of formula (I). The amount of other chromophores is preferably from 5 to 100% by weight, especially from 10 to 50% by weight, based on the total of the compounds of formula (I).

The optical recording disks comprising the compounds of formula (I) lead to excellent results when recorded and played back at 405 nm, particularly with respect to the reflectivity, modulation, jitter, PRSNR and/or SbER. As disclosed

above, it is possible to use them for high to low recording as well as for low to high recording.

Hence, the invention also pertains to an instant recording medium, wherein the maximum reflectivity of the recording track after recording is from 14 to 28%, on which track pits are writable with a 405 ± 5 nm laser of power 7 ± 5 mW, and the modulation of the pits measured with a 405 ± 5 nm laser of power 0.4 ± 0.2 mW is at least 30%, preferably from 38 to 60%. The instant optical recording media are thus compatible with the HD DVD-R™ standard.

The modulation is defined as usual in the art as the ratio of the reflectivity (R) change before and after the pit mark formation: modulation [expressed in %] = $(R_{max} - R_{min}) / R_{max}$.

The invention further pertains to an instant recording medium, wherein the reflectivity of the recording track after recording is from 10 to 30%, preferably from 12 to 25%, on which track pits are writable with a 405 ± 5 nm laser of power 5 ± 4 mW, and the modulation of the pits measured with a 405 ± 5 nm laser of power 0.35 ± 0.15 mW is at least 30%, preferably from 38 to 60%. The instant optical recording media are thus compatible with the Blu-ray Disk™ standard, too.

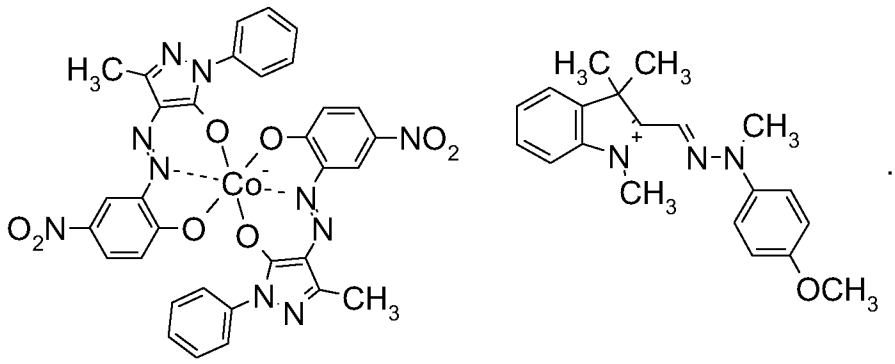
Upon irradiation with a laser having a wavelength of 350-500 nm, the optical properties of the instant compounds change in a fully unexpected way. The imaginary part of the complex index of refraction (k) is readily lowered with high sensitivity, while the real part of the index of refraction (n) remains significant without changing much. Surprisingly, this unique combination leads to optical recording systems wherein the reflectivity decreases upon irradiation with a laser of power 5 ± 4 mW having a wavelength of 350-500 nm. Extremely advantageously, it is possible to use a standard groove geometry, preferably the geometry matching the Blu-ray Disc™ standard such as described above. Likely owing to light interference phenomena, disks can be made which are either suitable for use with high to low recording polarity or show improved performance when used with low to high recording polarity.

Such high to low optical recording medium has preferably a reflectivity of from 10 to 30%, preferably from 12 to 25%, and a reflectivity of from 0 to 20%, preferably from 1 to 15% after irradiation with a laser of power 5 ± 4 mW having a wavelength of 350-500 nm. Preferably, the compound of formula (I) used in such medium has an index of refraction (n) of 1.5 ± 0.4, especially 1.5 ± 0.25, most preferred 1.5 ± 0.15, with an extinction coefficient (k) of more than 0.20, typically from 0.25 to 0.60, especially from 0.25 to 0.50, most preferred from 0.30 to 0.40 at the laser writing and/or reading wavelength.

Highly surprisingly, the invention therefore provides an optical recording medium which is compatible with the Blu-ray Disc™ standard, enabling to use existing readers.

The examples which follow illustrate the invention, without limiting it ("%" are by weight where not otherwise specified):

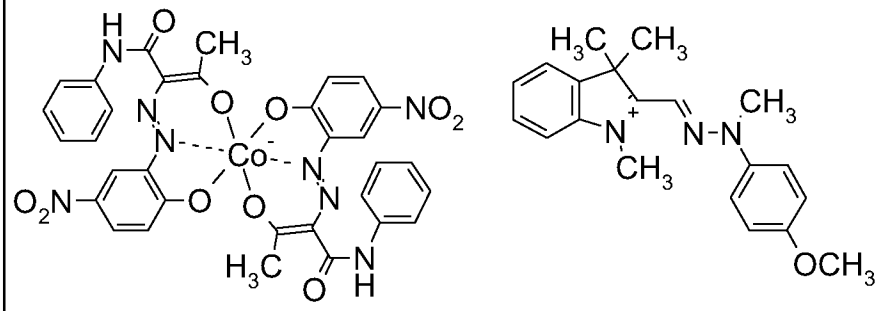
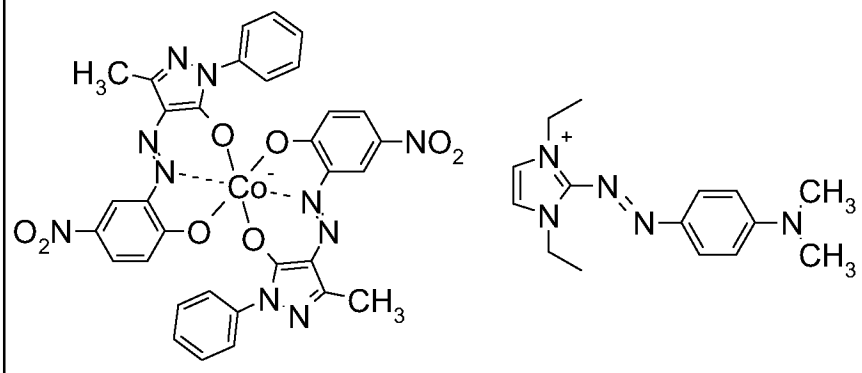
Example 1: 48 g of ORASOL® orange G (Ciba Specialty Chemicals Inc., humid, around 80% solid contents) are dissolved in 2 liters of methanol and filtered. To this solution is added a solution of 17.5 g MAXILON® Goldyellow GL (Ciba Specialty Chemicals Inc.) in 500 ml of methanol. The mixture is stirred for 4 hours at 23°C. The dark brown solution is cooled to 10°C, then filtered with suction. The suction-filtered material is washed with ice cooled 500 ml of methanol and dried for 24 hours at 50°C / 10^3 Pa, yielding 33.5 g red product of formula:

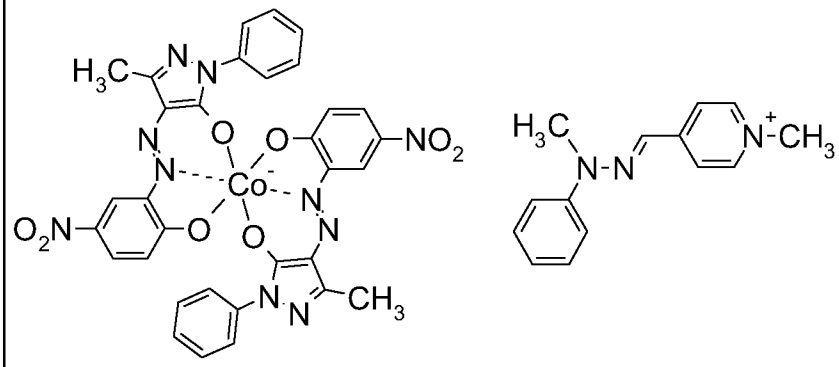
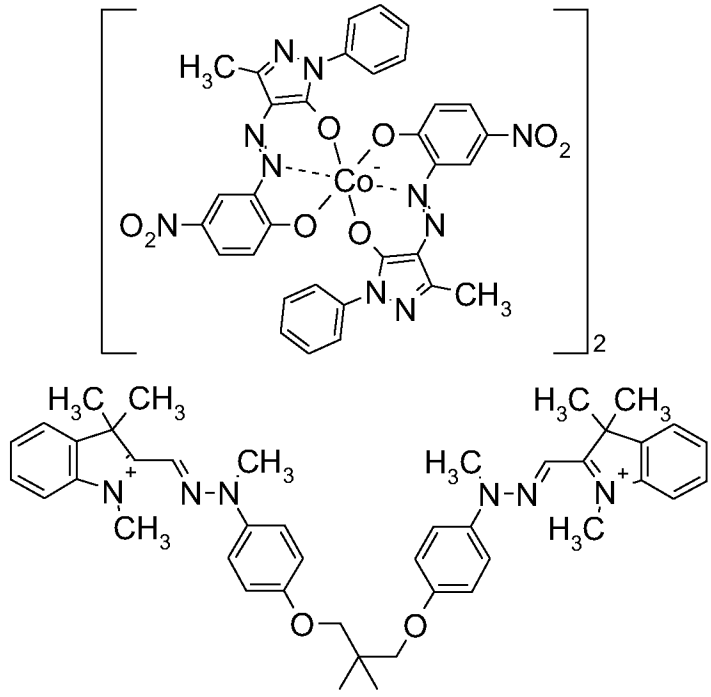
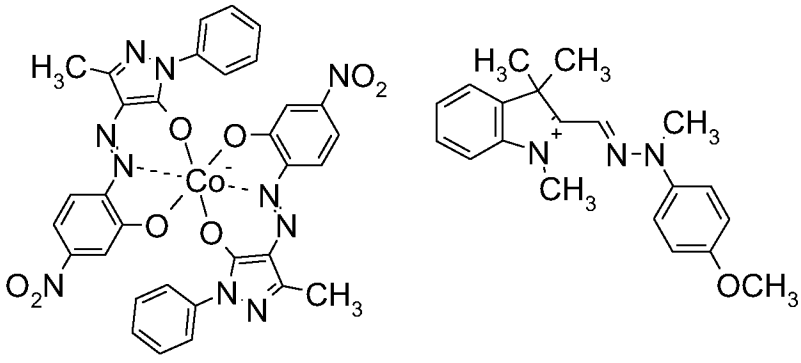


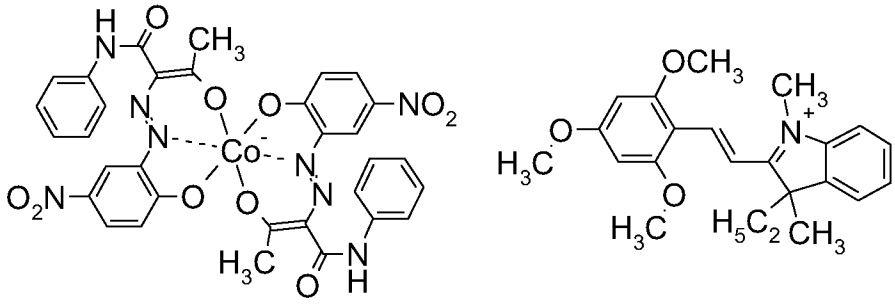
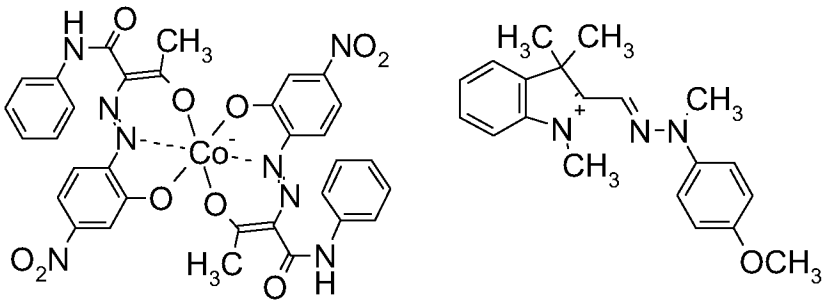
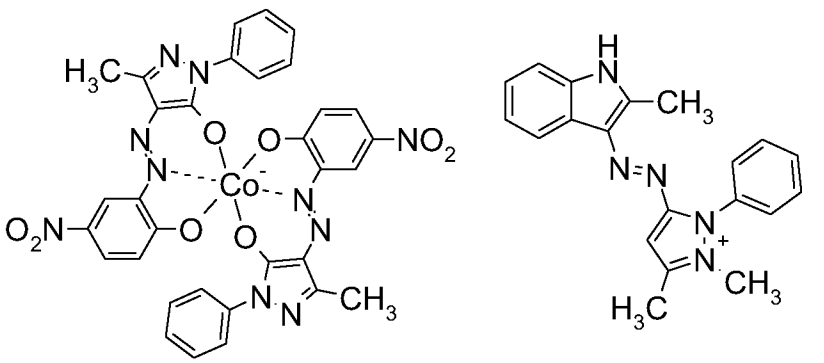
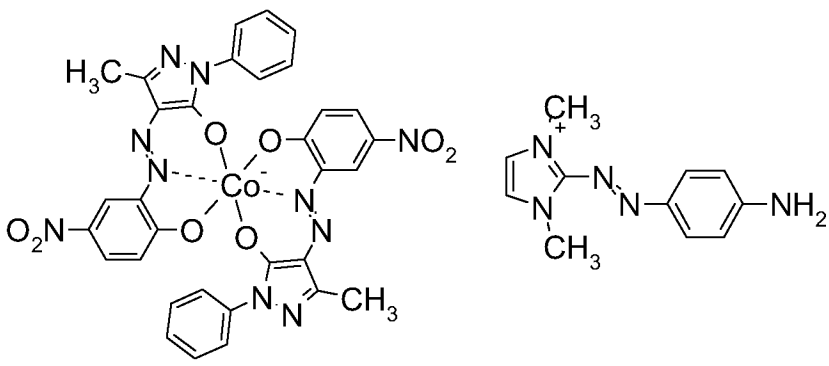
Example 2: 1.5 g of the compound according to example 1 are dissolved in 98.5 g of 2,2,3,3-tetrafluoropropanol and filtered through a 0.2 µm Teflon™ filter. The dye

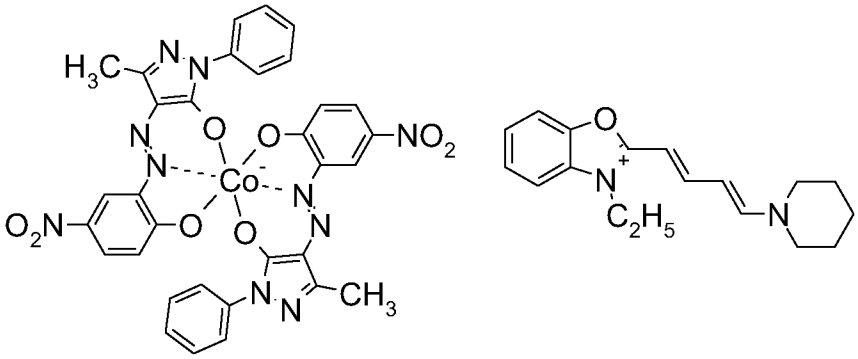
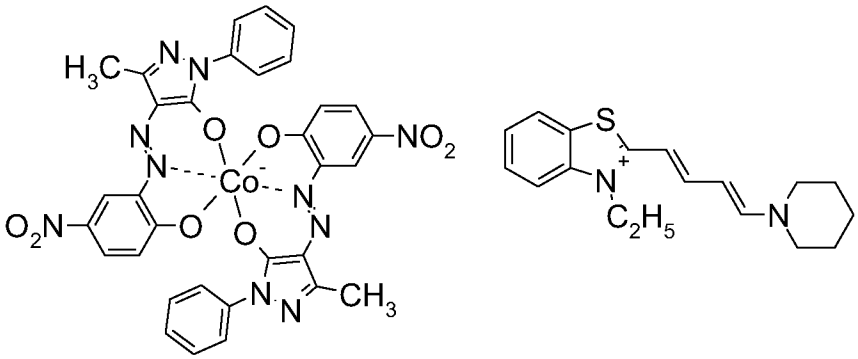
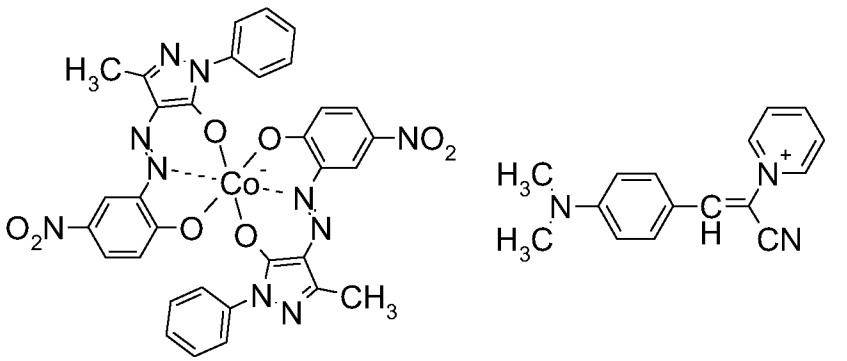
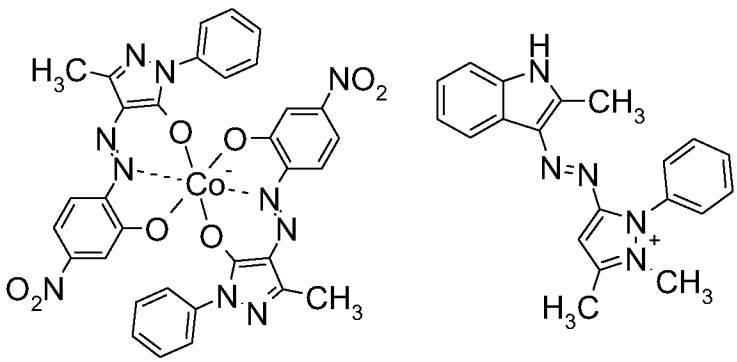
solution is then applied at 250 rev/min to a 1.2 mm thick, planar polycarbonate disc (diameter 120 mm) and the speed of rotation is increased to 1200 rev/min so that the excess of solution is spun off and a uniform solid layer is formed. After drying at 70°C for 20 minutes, the layer thickness and the complex refractive index of the solid layer are determined by means of spectral transmission and reflection measurements using an optical measuring system (ETA-RT™, ETA-Optik GmbH, Germany). At 405 nm, the dye layer has a refractive index n of 1.52 and an extinction coefficient k of 0.37. The photostability is determined with a calibrated xenon lamp (Hanau), the relative decrease in absorption $-D_{24}$ measured after 24 hours' irradiation is 4%.

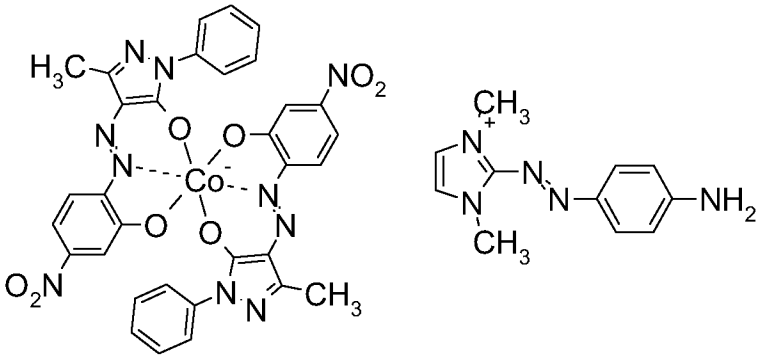
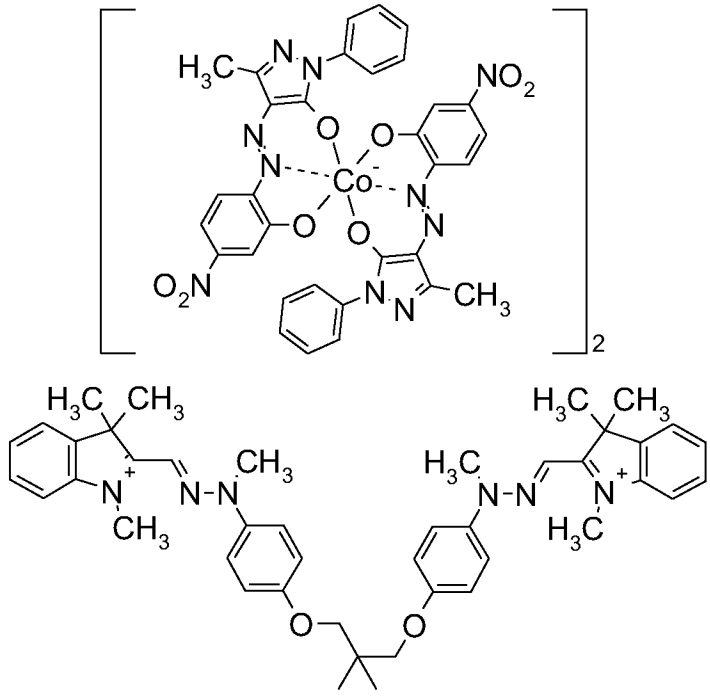
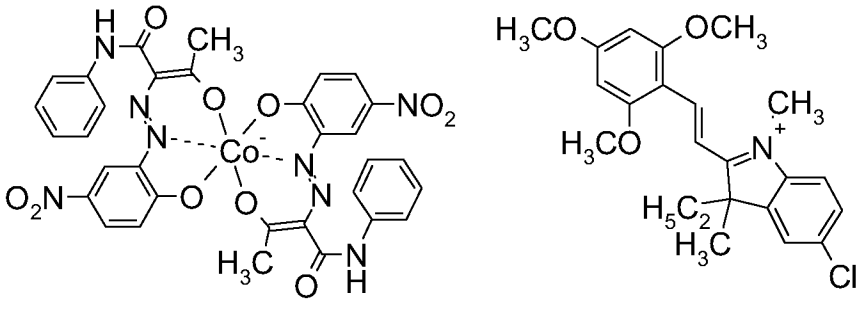
Examples 3 – 73:The following compounds are made and measured in analogy with example 2:

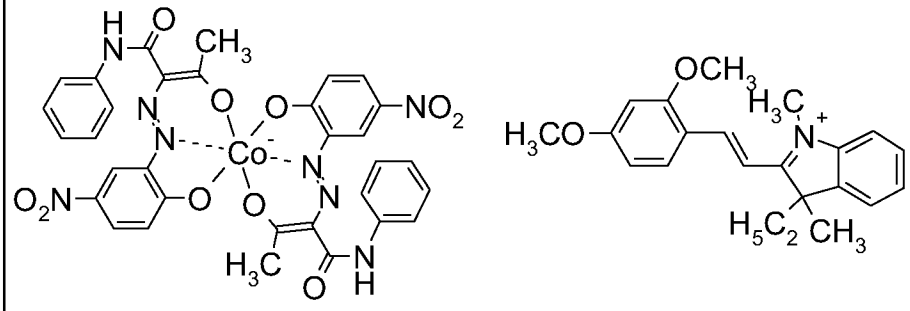
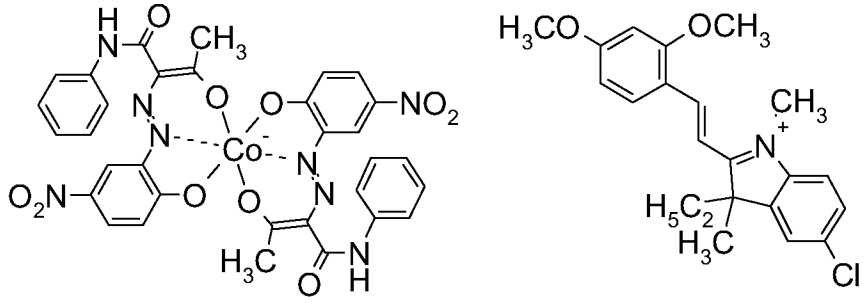
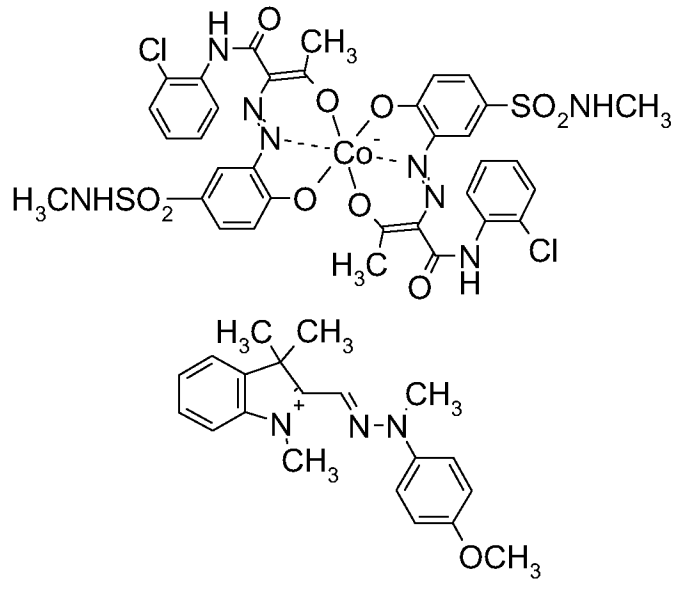
	Compound	n (405 nm)	k (405 nm)
3		1.48	0.42
4		1.53	0.32

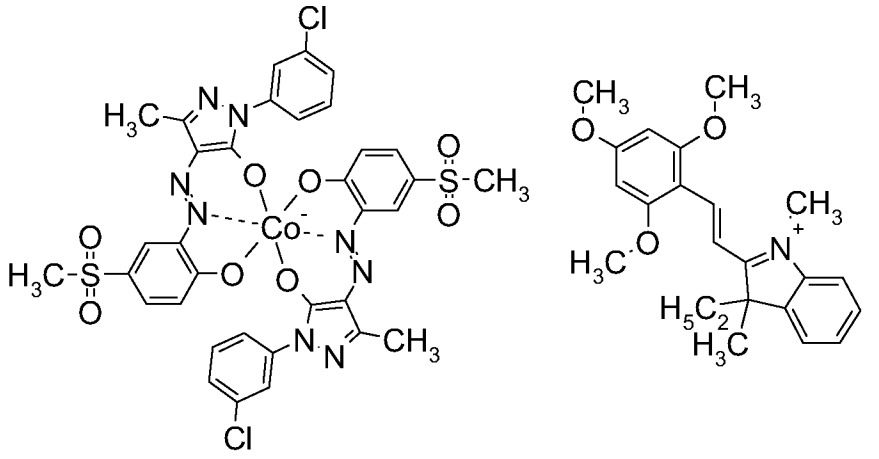
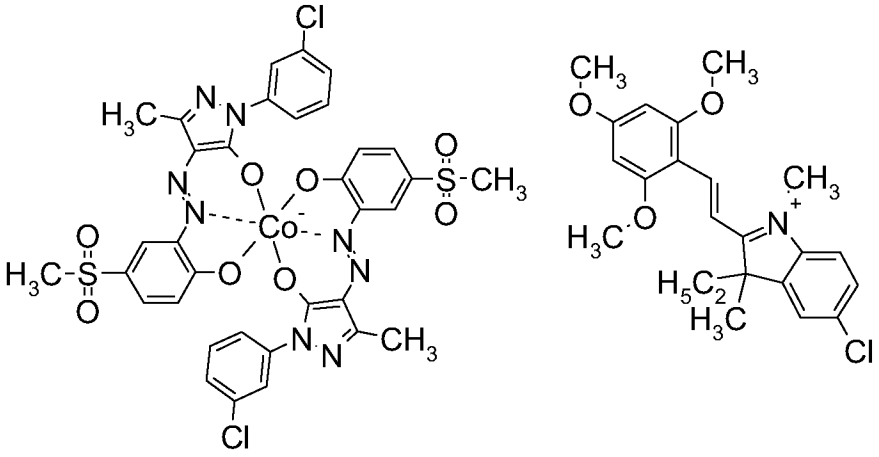
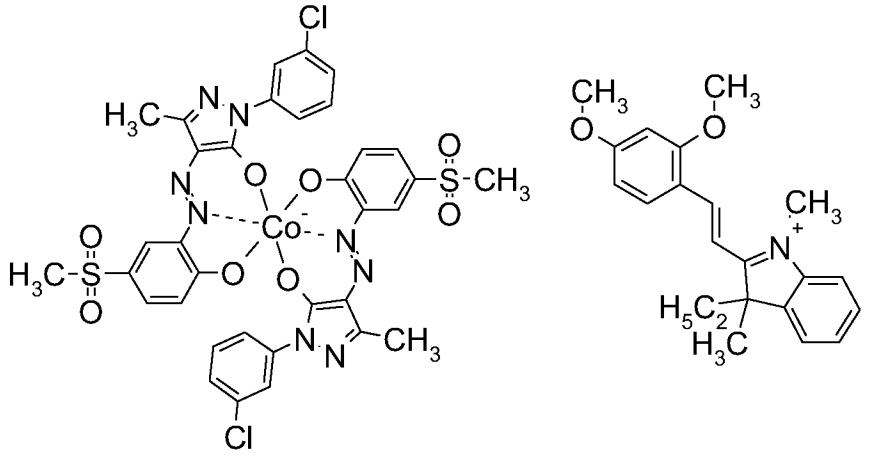
	Compound	n (405 nm)	k (405 nm)
5		1.41	0.46
6		crystallizes	
7		1.50	0.24

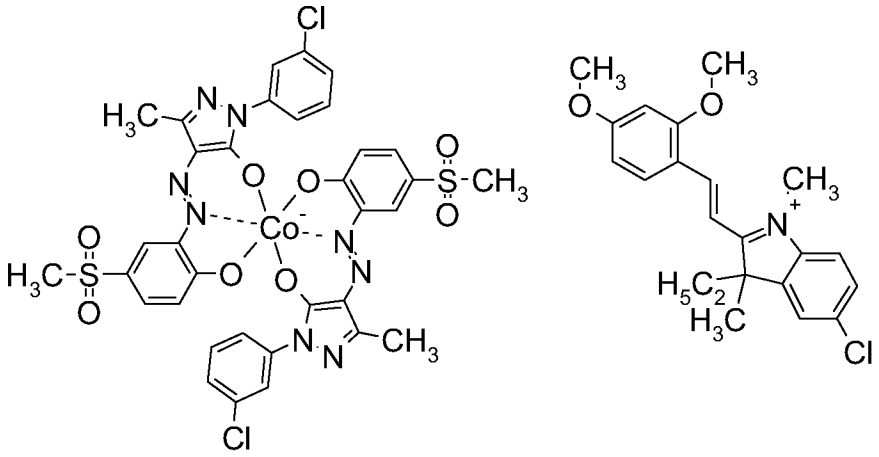
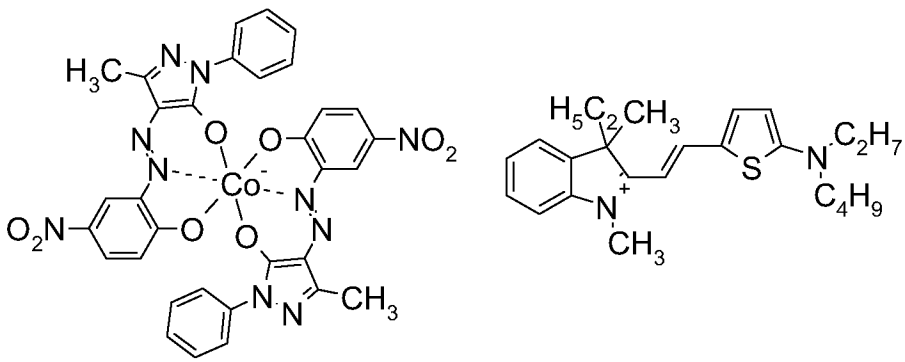
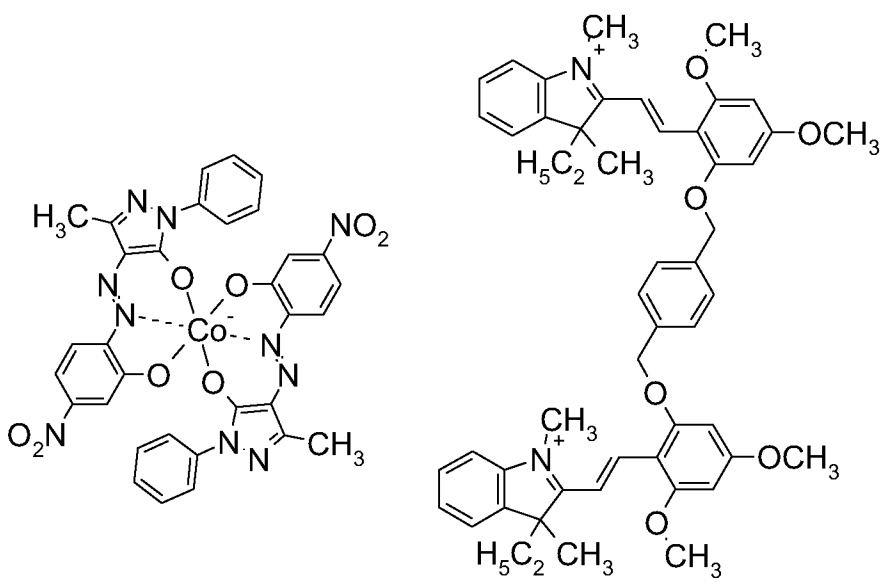
	Compound	n (405 nm)	k (405 nm)
8		1.46	0.41
9		1.51	0.24
10		lowsolub ilityin 2,2,3,3-tetrafluoropropanol	
11		low solubility in 2,2,3,3-tetrafluoropropanol	

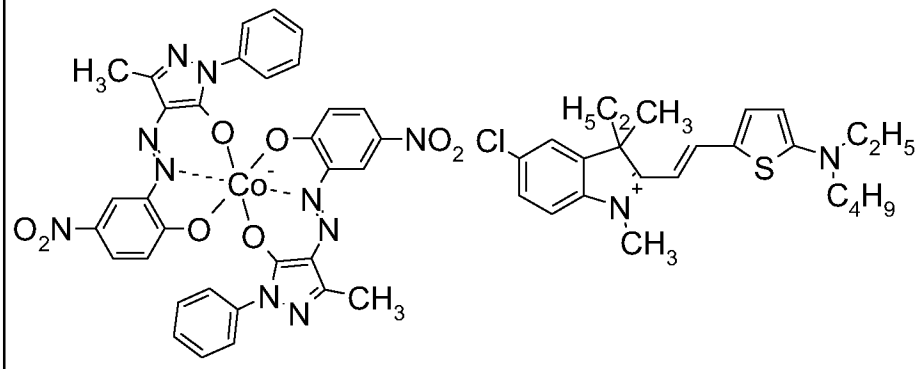
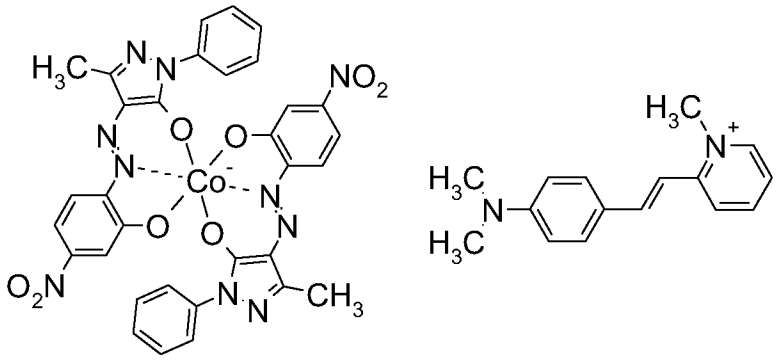
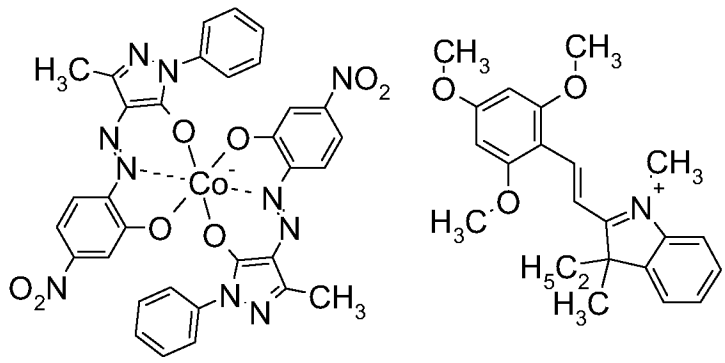
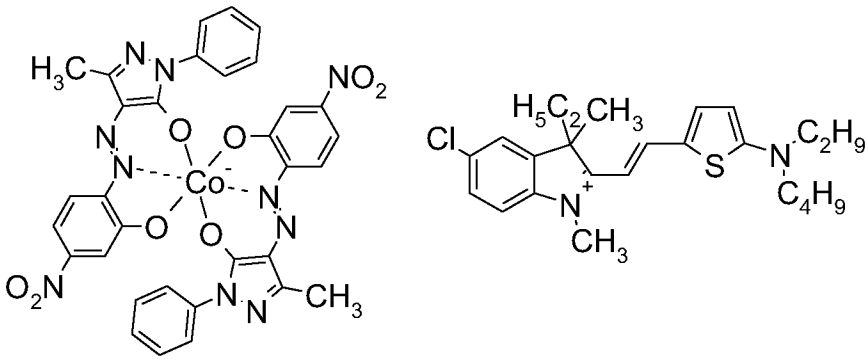
	Compound	n (405 nm)	k (405 nm)
12		1.43	0.42
13		1.47	0.33
14		1.52	0.39
15		low solubility in 2,2,3,3-tetrafluoropropanol	

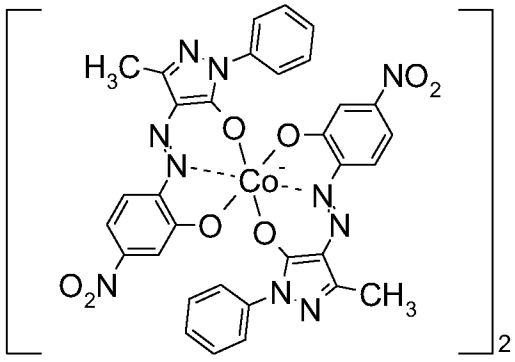
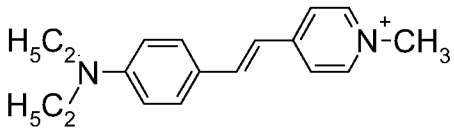
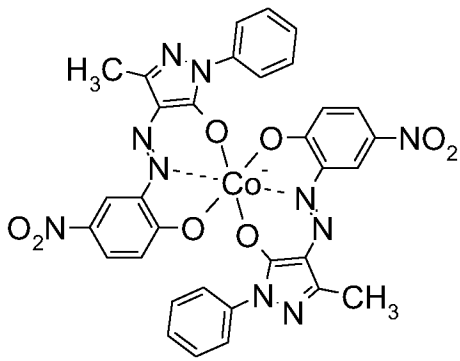
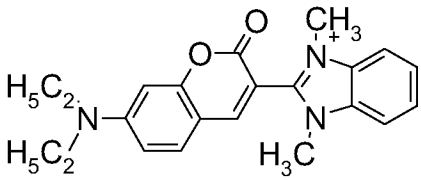
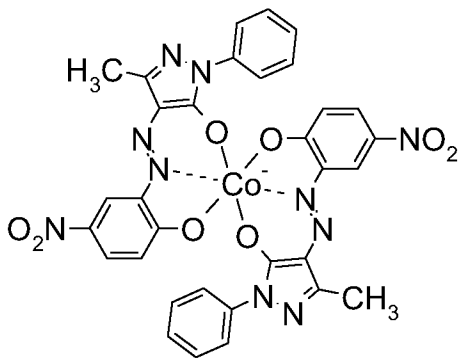
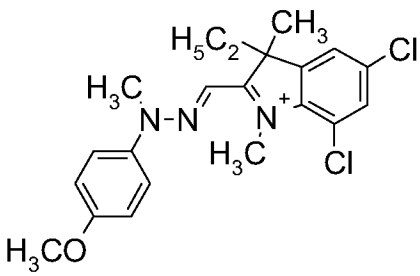
	Compound	n (405 nm)	k (405 nm)
16		low solubility in 2,2,3,3-tetrafluoropropanol	
17		1.44	0.33
18		1.49	0.37

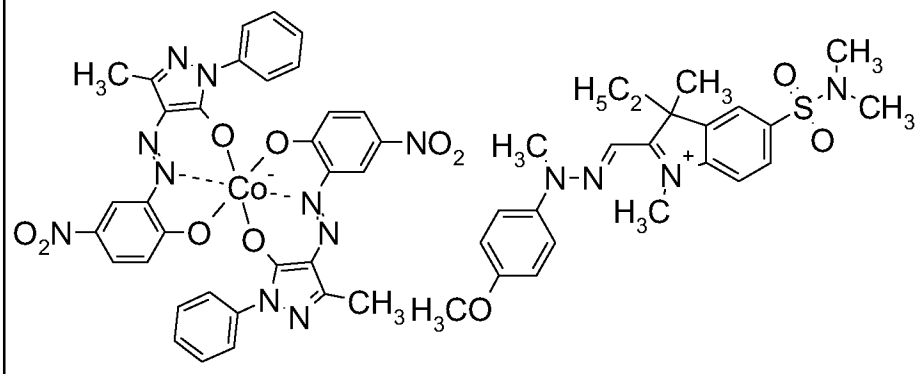
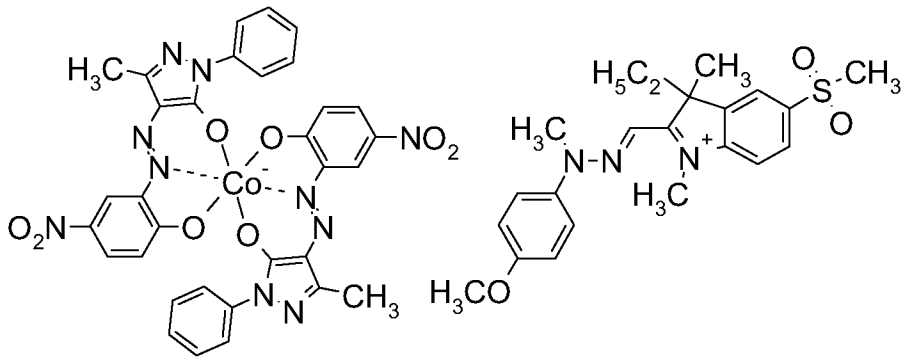
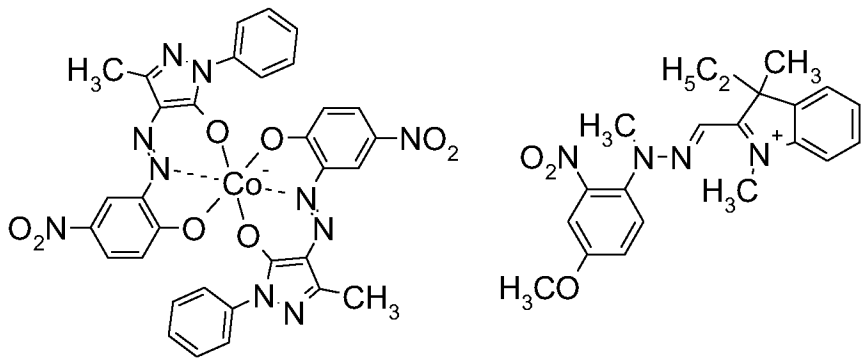
	Compound	n (405 nm)	k (405 nm)
19		1.46	0.41
20		1.44	0.41
21		1.55	0.27

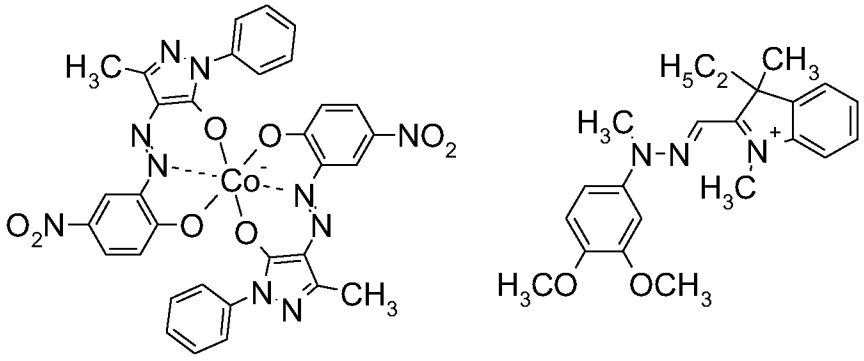
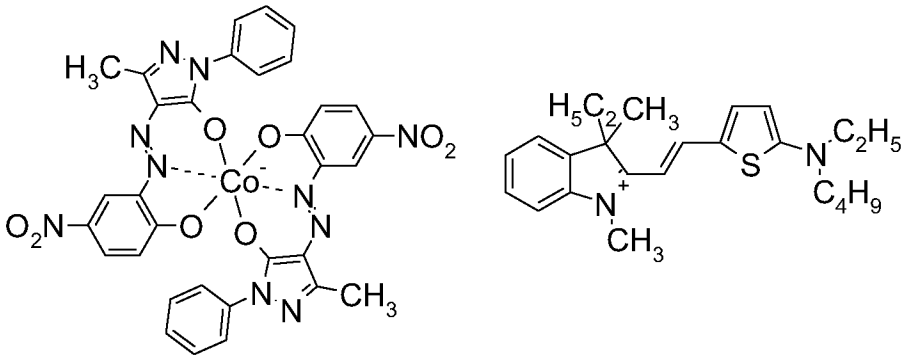
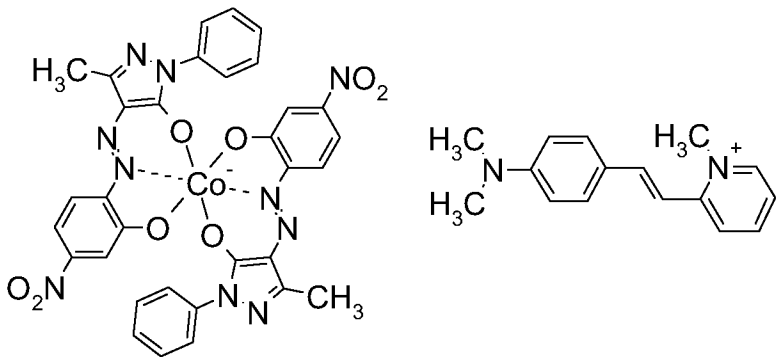
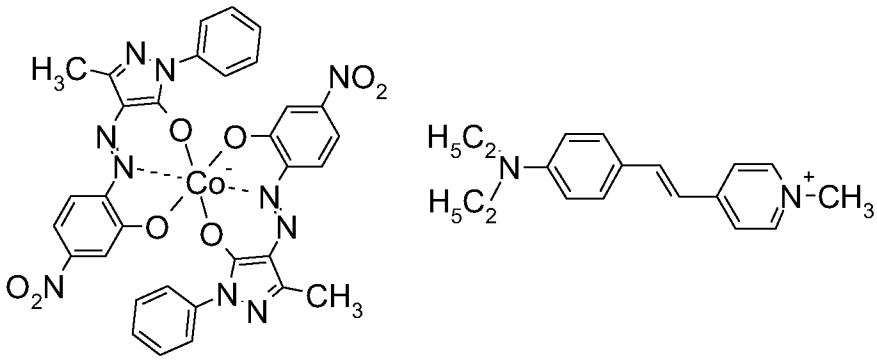
	Compound	n (405 nm)	k (405 nm)
22		1.47	0.19
23		1.47	0.19
24		1.49	0.21

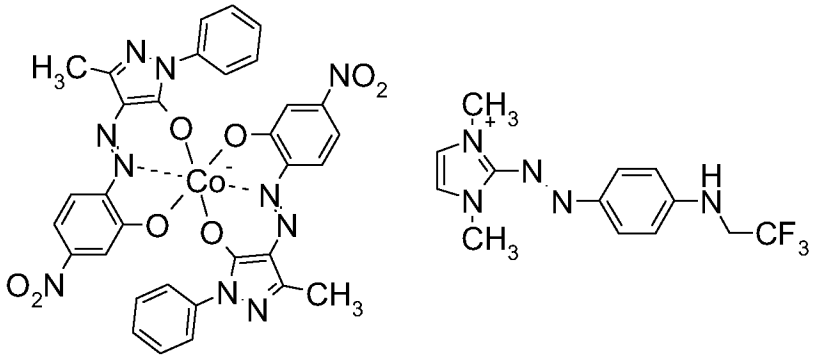
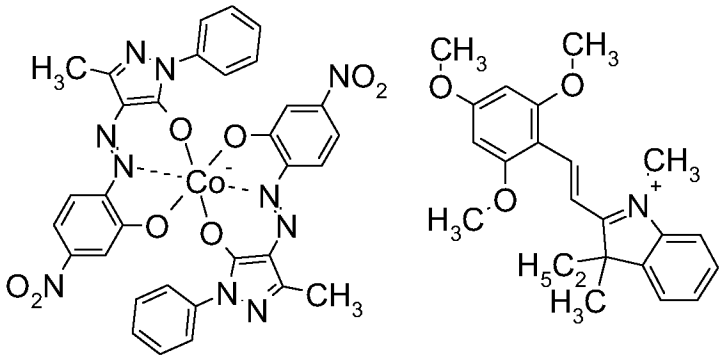
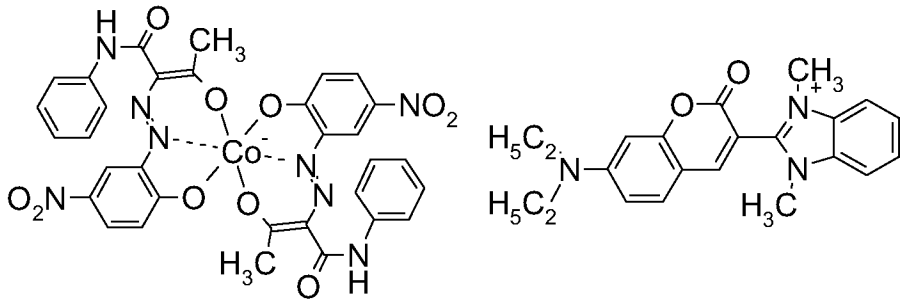
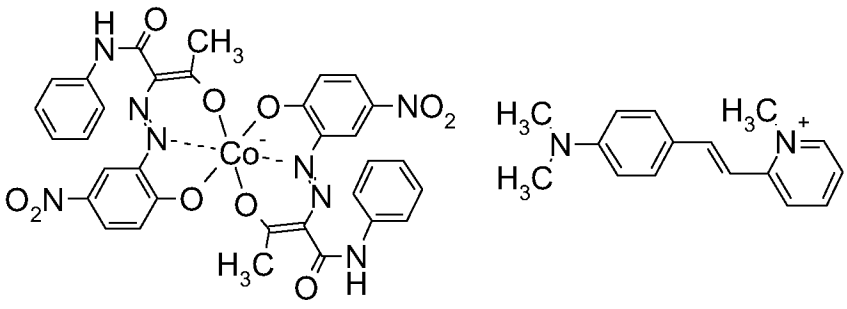
	Compound	n (405 nm)	k (405 nm)
25		1.50	0.19
26		1.54	0.26
27			

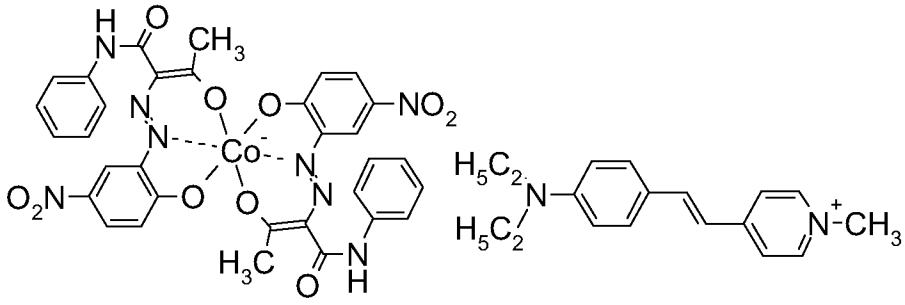
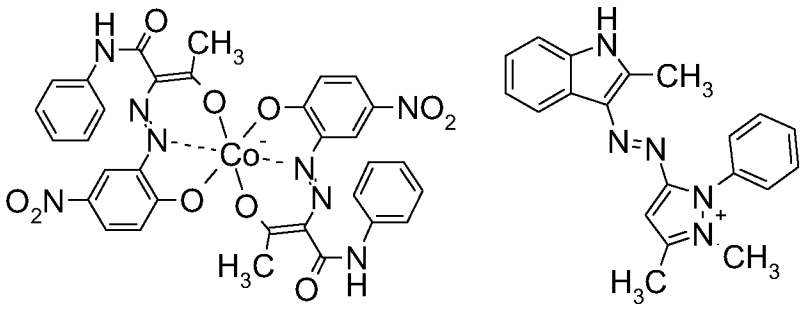
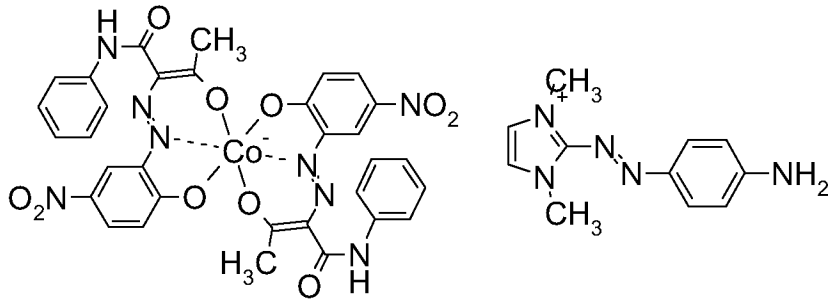
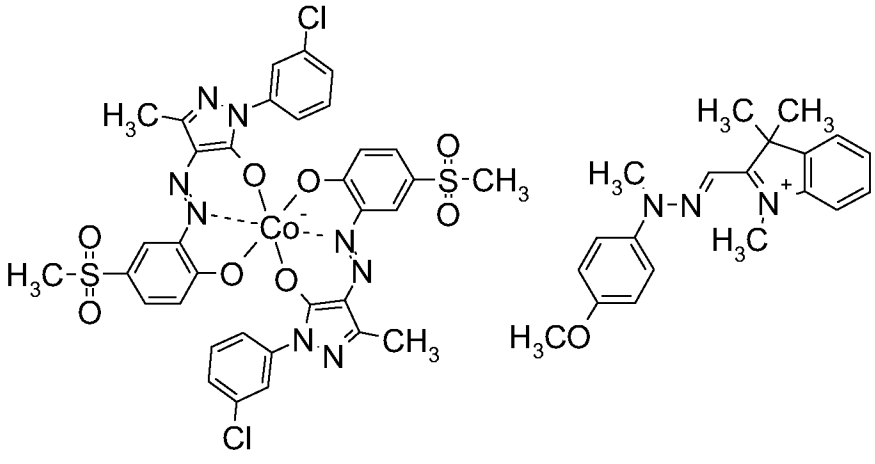
	Compound	n (405 nm)	k (405 nm)
28		1.57	0.25
29		1.55	0.21
30		1.53	0.22
31		1.59	0.13

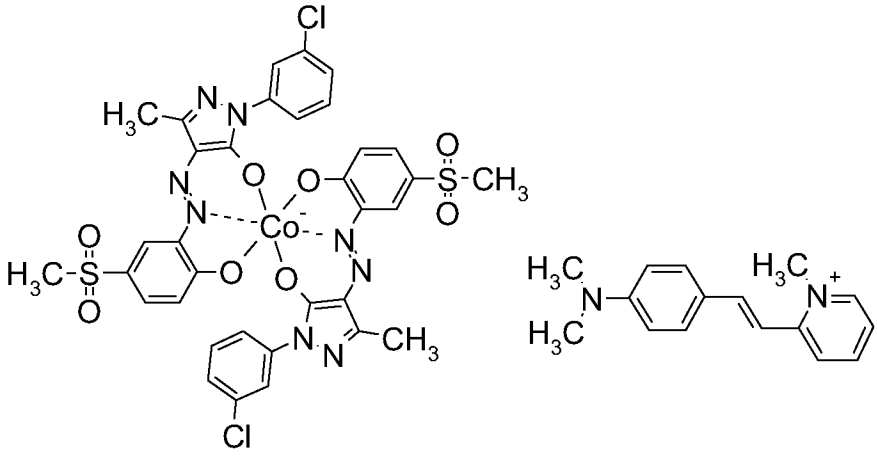
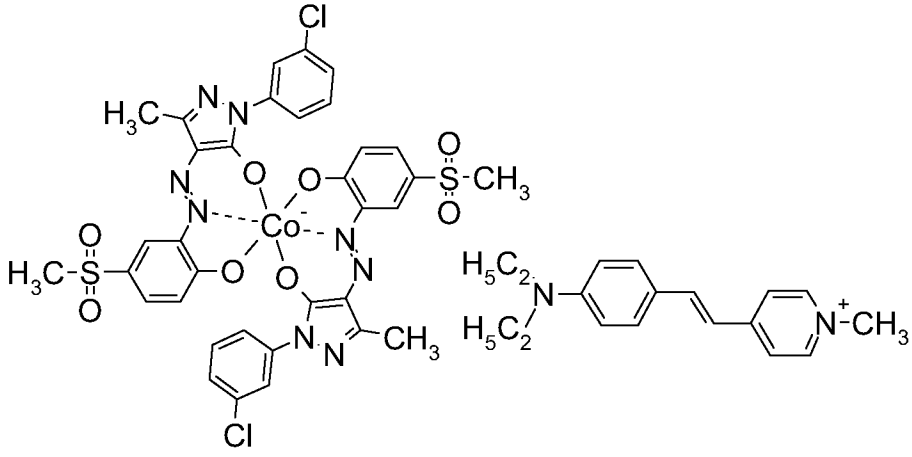
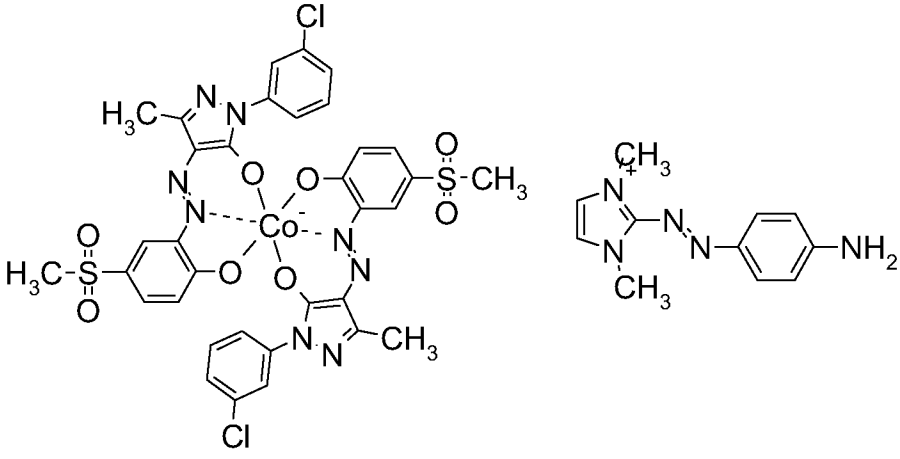
	Compound	n (405 nm)	k (405 nm)
32	 	1.54	0.18
33	 	1.49	0.39
34	 	1.48	0.34

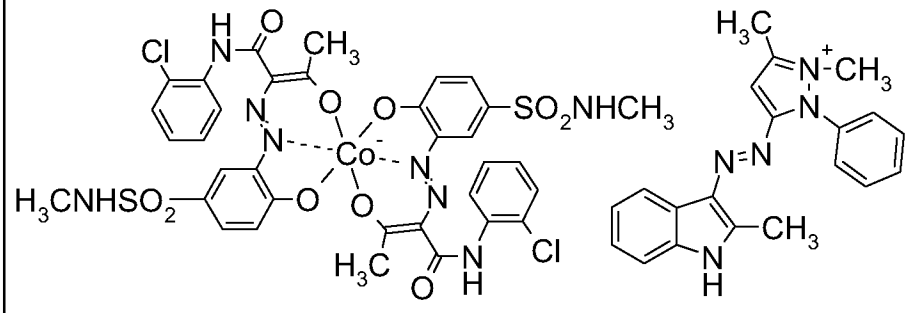
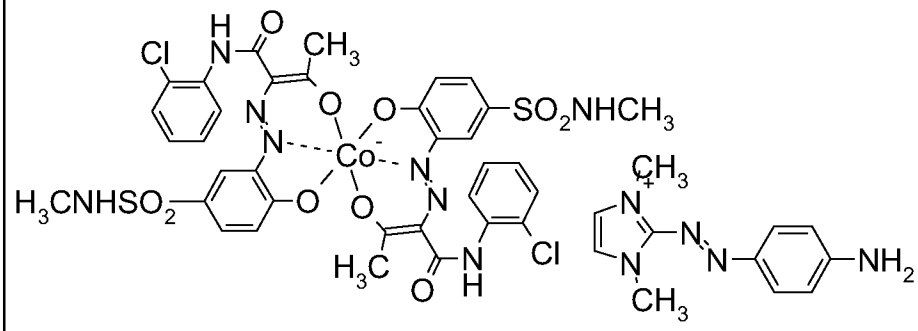
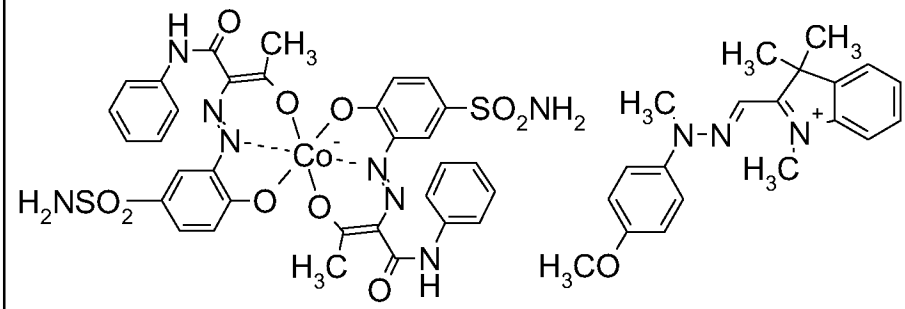
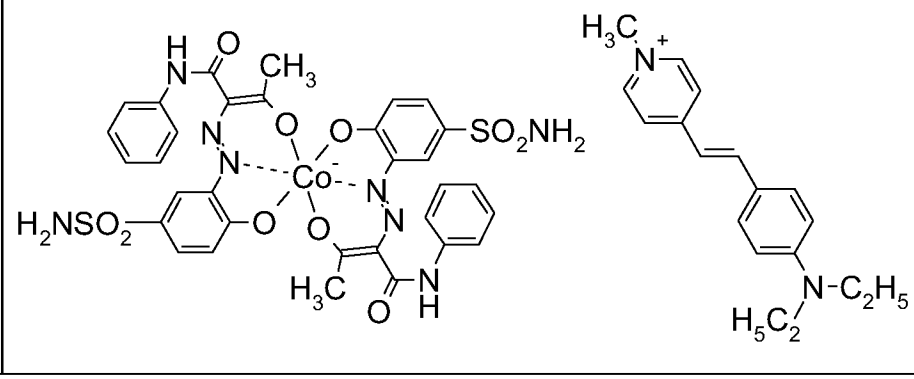
	Compound	n (405 nm)	k (405 nm)
35		1.52	0.32
36		1.52	0.33
37		1.45	0.46

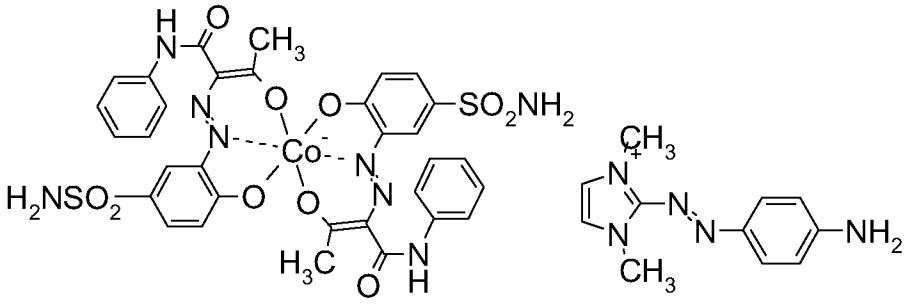
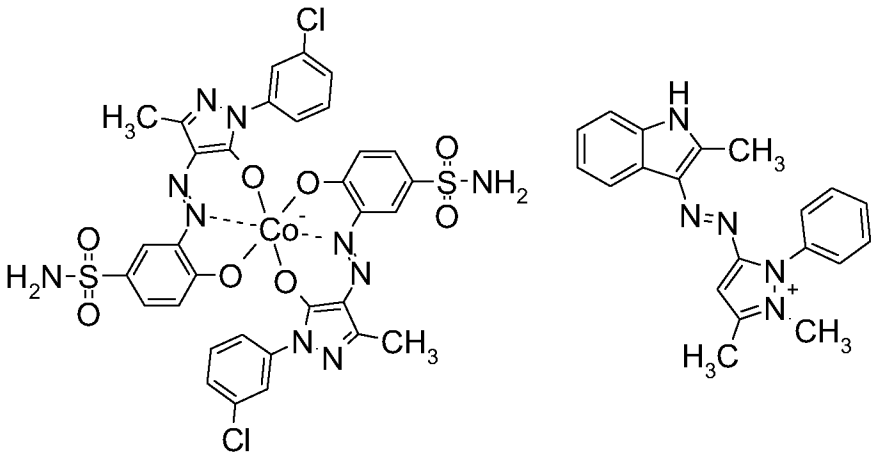
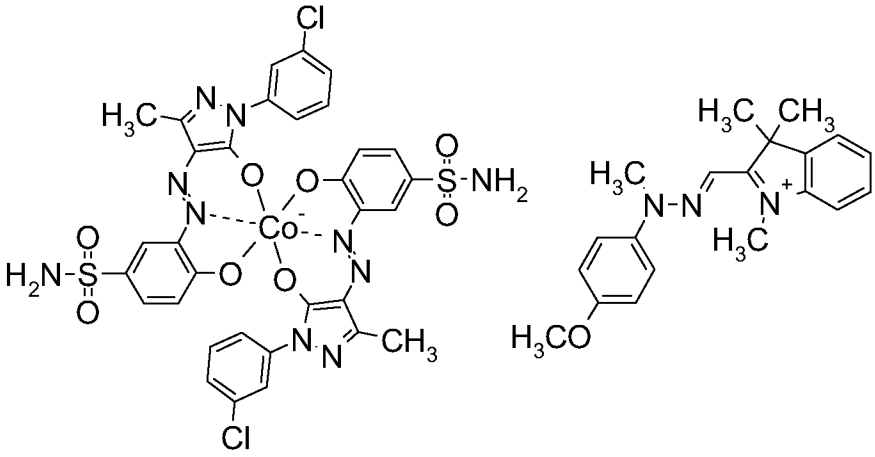
	Compound	n (405 nm)	k (405 nm)
38		1.47	0.36
39		1.54	0.26
40		1.55	0.21
41		1.54	0.18

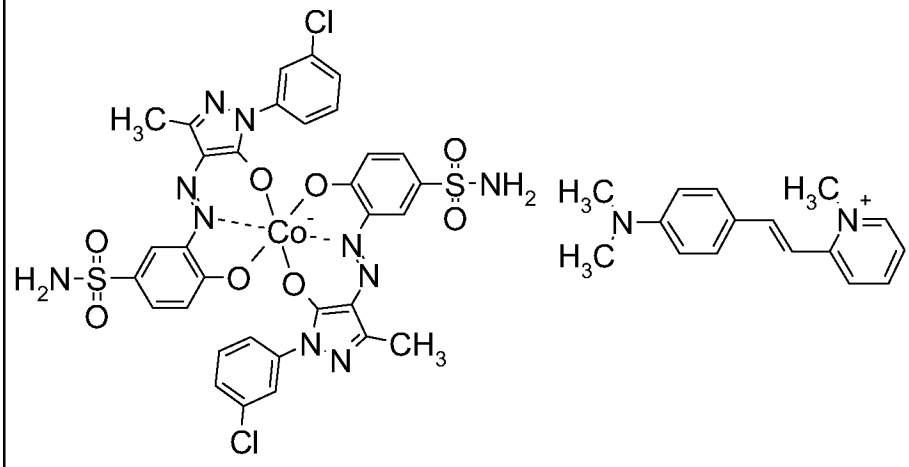
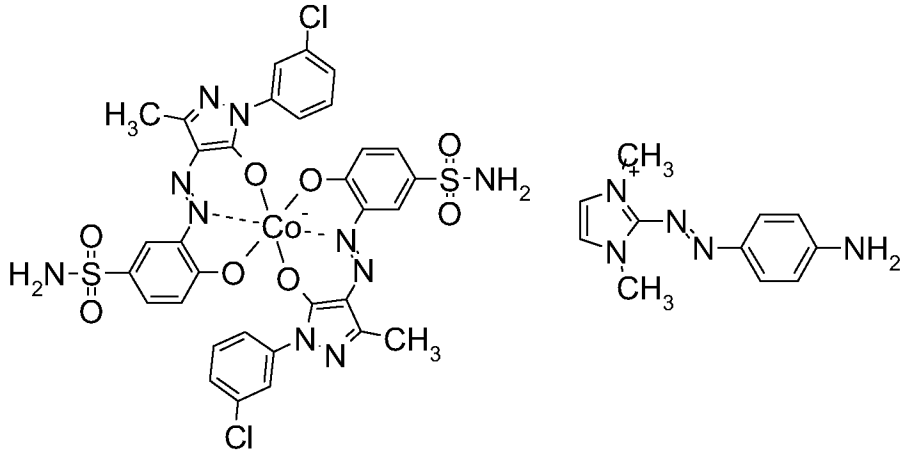
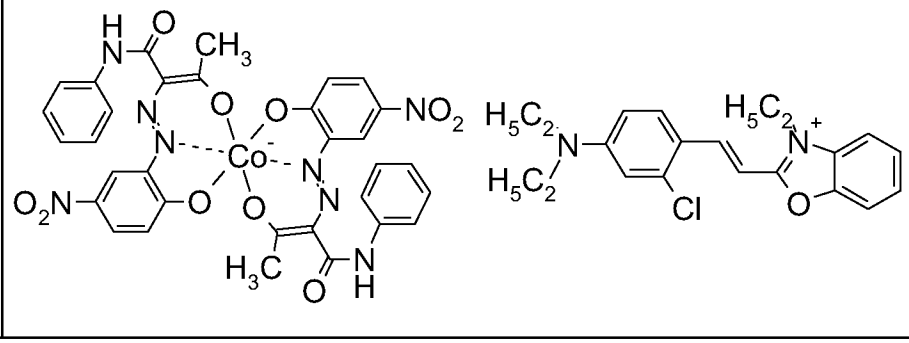
	Compound	n (405 nm)	k (405 nm)
42		1.53	0.22
43		1.53	0.22
44		1.49	0.44
45		1.53	0.39

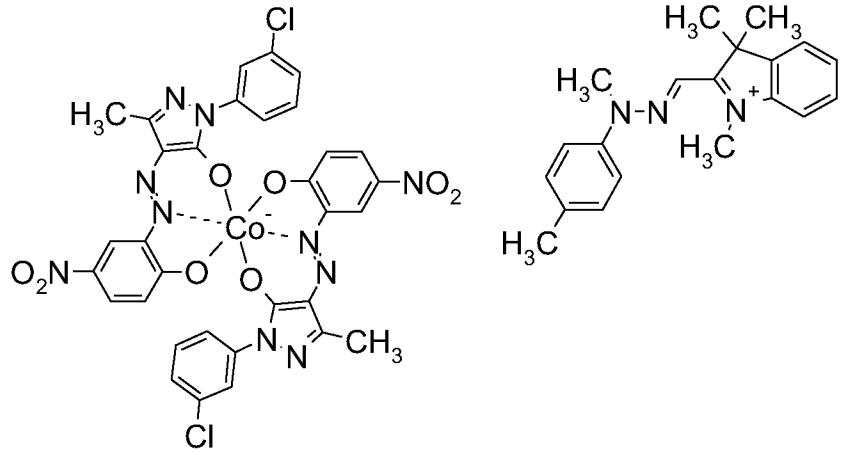
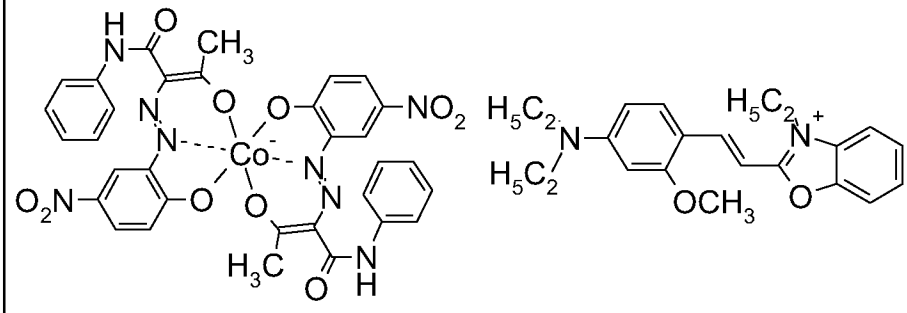
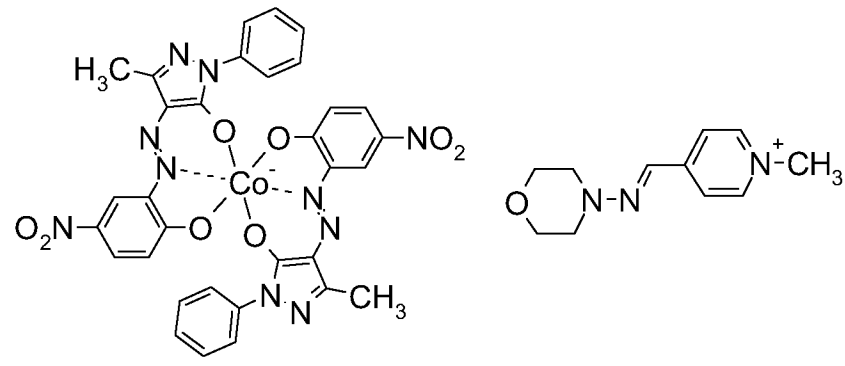
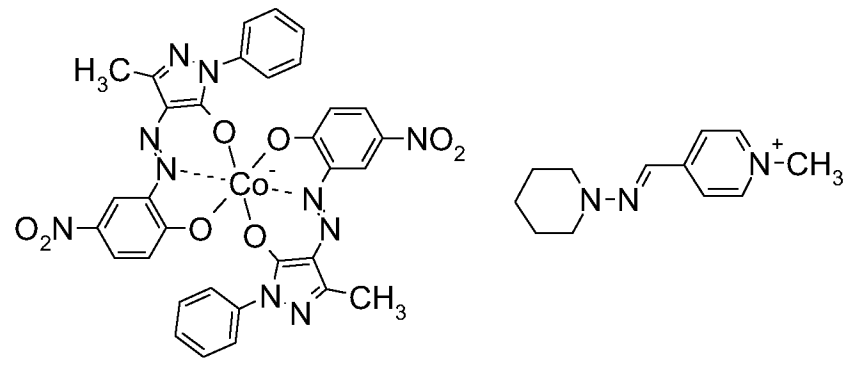
	Compound	n (405 nm)	k (405 nm)
46		1.53	0.34
47		1.47	0.43
48		1.50	0.43
49		1.53	0.23

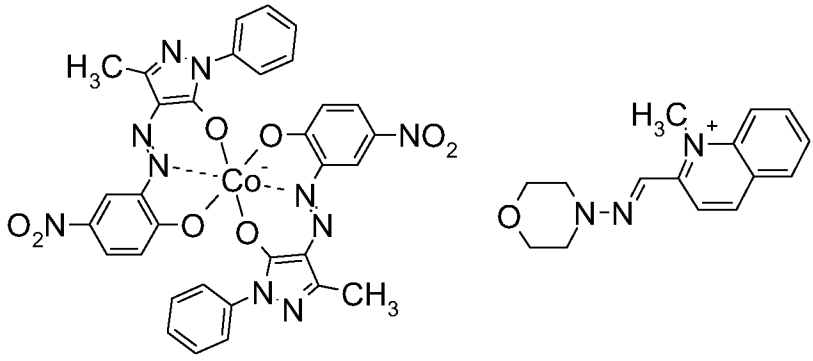
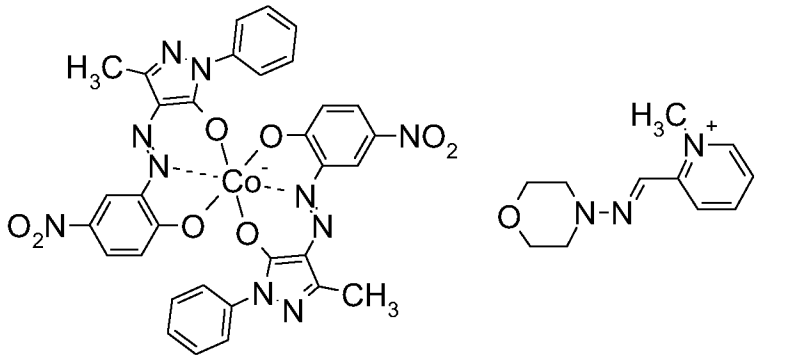
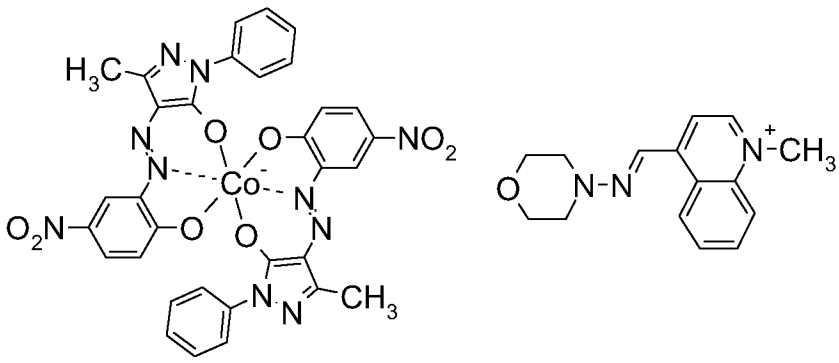
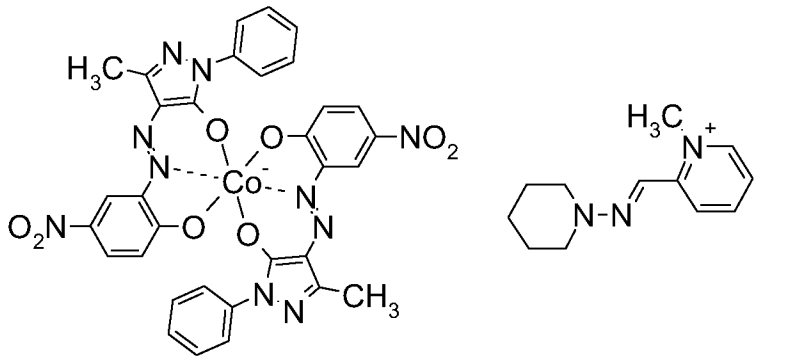
	Compound	n (405 nm)	k (405 nm)
50		1.54	0.221
51		1.55	0.13
52		1.46	0.23

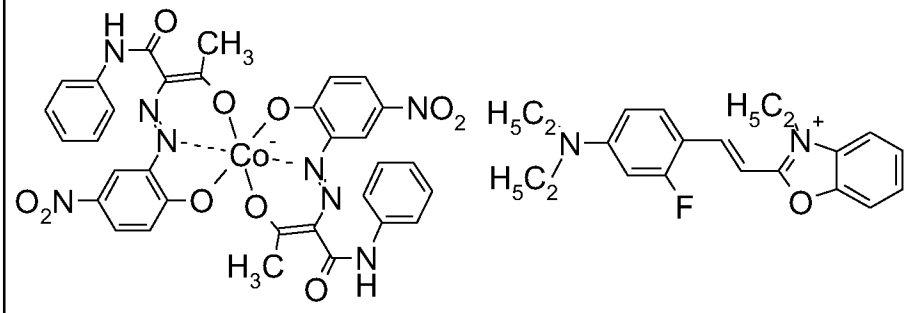
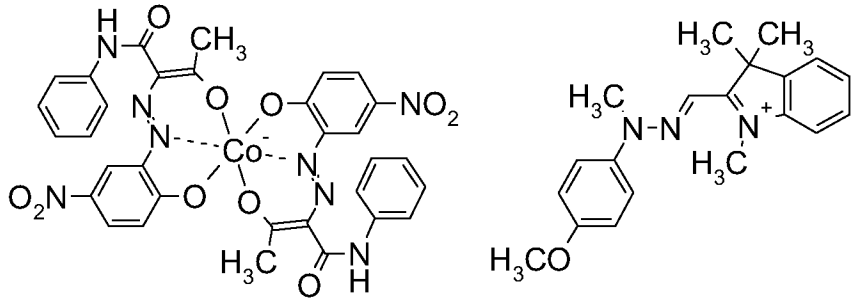
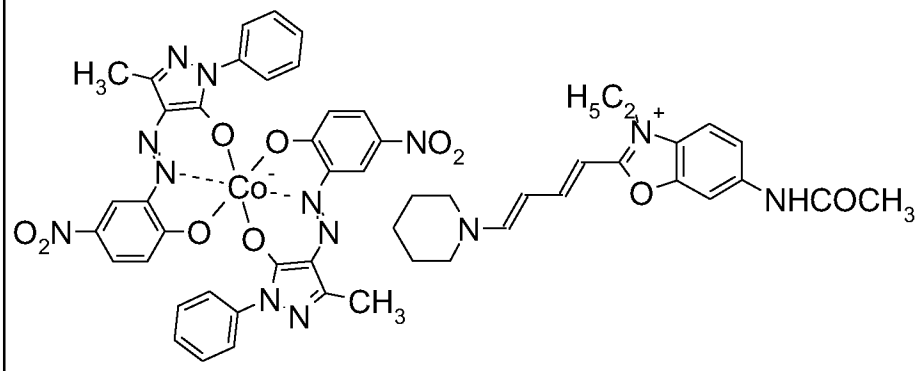
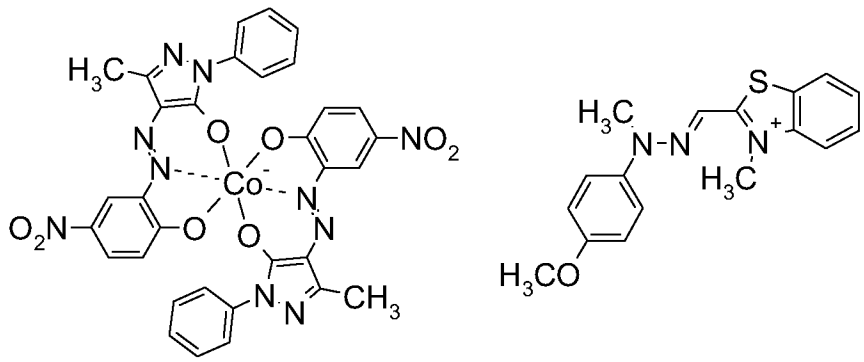
	Compound	n (405 nm)	k (405 nm)
53		1.58	0.28
54		1.54	0.26
55		1.55	0.30
56		1.50	0.24

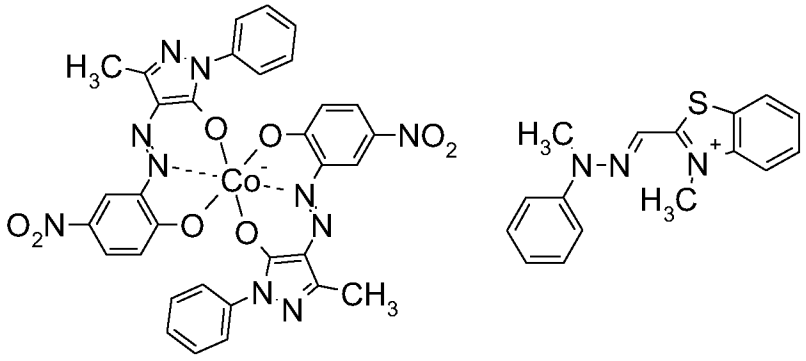
	Compound	n (405 nm)	k (405 nm)
57		1.54	0.29
58		1.53	0.25
59		1.51	0.22

	Compound	n (405 nm)	k (405 nm)
60		1.54	0.20
61		1.43	0.21
62		1.40	0.44

	Compound	n (405 nm)	k (405 nm)
63		1.44	0.42
64		1.45	0.35
65		1.81	0.42
66		1.75	0.48

	Compound	n (405 nm)	k (405 nm)
67		1.60	0.46
68		1.73	0.36
69		1.56	0.38
70		1.70	0.41

	Compound	n (405 nm)	k (405 nm)
71		1.28	0.42
72		1.38	0.45
73		1.35	0.42
74		low solubility in 2,2,3,3-tetrafluoropropanol	

	Compound	n (405 nm)	k (405 nm)
75		low solubility in 2,2,3,3-tetrafluoropropanol	

Example 76: 1.4 g of the compound according to example 1 is dissolved in 100 ml of 2,2,3,3-tetrafluoropropanol and filtered through a 0.2 µm Teflon™ filter. The dye solution is applied by spin-coating to the surface of a 0.6 mm thick, grooved polycarbonate disc (groove depth 50 nm, groove width 230 nm, track pitch 400 nm) having a diameter of 120 mm. The excess of solution is spun off by increasing the speed of rotation up to 4000 r.p.m. When the solvent is evaporated off, the dye remains behind in the form of a uniform, amorphous solid layer, characterized by an optical density of 0.46. Drying is carried out in a circulating-air oven at 70°C for 20 minutes. In a vacuum-coating apparatus (Swivel™, Unaxis) a 120 nm thick silver layer is then applied to the recording layer by sputter coating. An adhesive layer of a UV-curable photopolymer (XD 4760™, Huntsman) is then applied thereto by spin-coating, and a second polycarbonate disc (0.6 mm thick, 120 mm diameter) is adhesively bonded thereto. On a commercial test apparatus (ODU-1000™, Pulstec Japan), using a laser diode of wavelength 405 nm and a numerical aperture of 0.65, marks are written into the active layer at speeds of 6.61 $m \cdot s^{-1}$. Read out is then performed on the same apparatus by applying a read power of 0.4 mW and the following dynamic parameters are determined: optimum recording power, reflectivity, I11 / I11H modulation, 2T-11T signal asymmetry, CNR signal-to-noise ratio, multi-track PRSNR (Partial Response Signal to Noise Ratio) and SbER (Simulated bit Error Rate). The test results are summarized in the table below.

Best Optical Density	Optimum Laser power [mW]	Reflectivity R11H [%]	Modulation I11/I11H	2T – 11T Asymmetry	CNR [dB]	Multi-track PRSNR	Multi-track SbER
0.46	8.0	19.0	0.50	0.01	50.4	28	$2.2 \cdot 10^{-5}$

The recording characteristics are outstanding and overall meet the specifications of the HD DVD-R™ format. The smallest marks (2T) can be precisely written and detected, leading to particularly good signal asymmetries.

Example 77: It is proceeded analogously to example 76, with the difference that the product according to example 1 is replaced by the product according to example 3 .

Best Optical Density	Optimum Laser power [mW]	Reflectivity R11H [%]	Modulation I11/I11H	2T – 11T Asymmetry	CNR [dB]	Multi-track PRSNR	Multi-track SbER
0.45	9.0	19.4	0.48	0.03	22	$2.7 \cdot 10^{-6}$	0.45

Example 78: It is proceeded analogously to example 76, with the difference that the product according to example 1 is replaced by the product according to example 5.

Best Optical Density	Optimum Laser power [mW]	Reflectivity R11H [%]	Modulation I11/I11H	2T – 11T Asymmetry	CNR [dB]	Multi-track PRSNR	Multi-track SbER
0.43	8.0	15.6	0.54	0.03	21	$4.2 \cdot 10^{-4}$	0.43

Example 79: It is proceeded analogously to example 76, with the difference that the product according to example 1 is replaced by the product according to example 36.

Best Optical Density	Optimum Laser power [mW]	Reflectivity R11H [%]	Modulation I11/I11H	2T – 11T Asymmetry	CNR [dB]	Multi-track PRSNR	Multi-track SbER
0.40	8.5	22.0	0.43	0.01	25	$1 \cdot 10^{-7}$	0.40

Example 80: It is proceeded analogously to example 79, with the difference that the recording speed is set to 13.22 $m \cdot s^{-1}$ (2x).

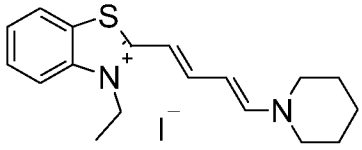
Best Optical Density	Optimum Laser power [mW]	Reflectivity R11H [%]	Modulation I11/I11H	2T – 11T Asymmetry	CNR [dB]	Multi-track PRSNR	Multi-track SbER
0.40	11.5	23.6	0.40	-0.01	22	$3 \cdot 10^{-6}$	0.40

Examples 81 – 143: It is proceeded analogously to example 76, with the difference that the product according to example 1 is replaced by the products according to examples 4, 7 – 9, 12 – 14, 17 – 35 and 37 – 73, respectively.

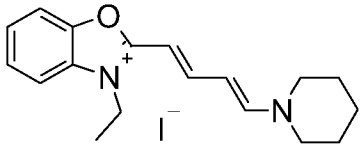
Example 144: 5.00 g of 3-ethyl-2-methylbenzthiazolium iodide and 5.45 g of 3-anilinoacrylanilide hydrochloride are introduced into 40 ml of acetic anhydride in a 100 ml multi-necked flask equipped with a magnetic stirrer, thermometer and nitrogen transfer line. The mixture is heated to reflux for 15 minutes, then quickly cooled with an ice bath. 50 ml of tert.-butyl-methylether are added dropwise and the suspension is stirred for 1 hour, then filtered. The residue is washed three times with 20 ml of ice-cold tert.-butyl-methylether then dried at 50°C / $2.5 \cdot 10^3$ Pa. Brown crystals of 2-[4-(acetyl-phenyl-amino)-buta-1,3-dienyl]-3-ethyl-benzthiazol-3-ium iodide are obtained in 70% yield.

5.9 g 2-[4-(acetyl-phenyl-amino)-buta-1,3-dienyl]-3-ethyl-benzthiazol-3-ium iodide and 58 ml of ethanol are introduced into a 250 ml multi-necked flask equipped with a magnetic stirrer, thermometer and nitrogen transfer line. 3.20 g of piperidine are added dropwise within 5 minutes. The mixture is heated to reflux for 30 minutes, then quickly cooled with an ice bath. Slowly, 150 ml of diethylether are added

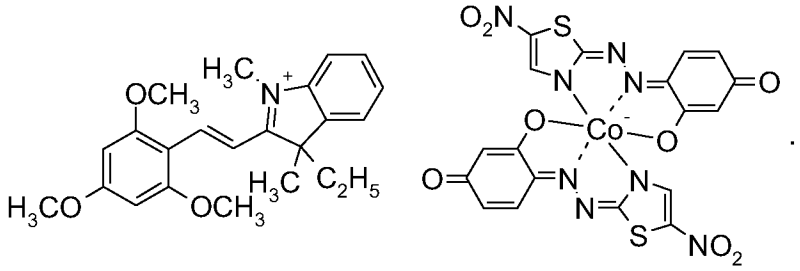
dropwise and the suspension is stirred for 1 hour, then filtered. The residue is washed three times with 20 ml of diethylether then dried at 50°C / $2.5 \cdot 10^3$ Pa. Red crystals of 3-ethyl-2-((1,3)-4-piperidin-1-yl-buta-1,3-dienyl)-benzthiazol-3-ium iodide are obtained in 89% yield:



Example 145: It is proceeded analogously to example 144, but replacing 3-ethyl-2-methylbenzthiazolium iodide by 3-ethyl-2-methylbenzoxazolium iodide. The product of following formula is obtained:



Example 146: It is proceeded analogously to example 76, with the difference that Dual Layer HD DVD-R™ disks comprising two recording layers are made, wherein the outer recording layer (L0) has the same composition as in example 1, and the inner recording layer (L1) consists essentially of the compound of the formula:

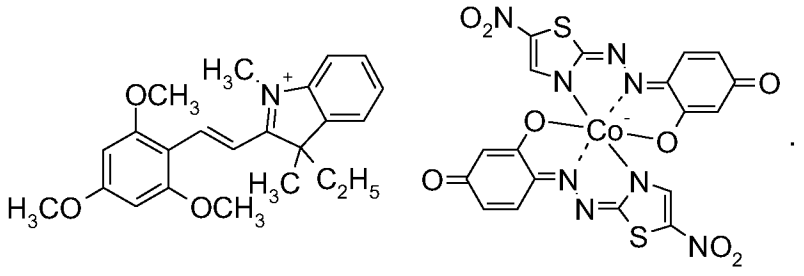


The disc is constructed following the “inverted stack” manufacturing procedure. The L0 half disc is made essentially as described in example 76, with the exception that a 10 nm thick silver layer is applied to the recording layer by sputtering forming a semi-transparent layer. For the L1 half disc, a 120 nm thick silver layer is applied onto a second grooved polycarbonate substrate (groove depth 20 nm, groove width 220 nm, track pitch 400 nm). 2.8 g of the compound of above formula are dissolved in 100 ml of 2,2,3,3-tetrafluoropropanol and filtered through a 0.2 µm Teflon™ filter.

The dye solution is applied by spin-coating onto the silver layer of the L1 half disc, forming a uniform, amorphous solid layer, with an optical density of 0.65. Drying is carried out in a circulating-air oven at 70°C for 20 minutes. In a vacuum-coating apparatus, a 10 nm thick SiN layer is then applied to the recording layer by DC sputtering. An adhesive layer of a UV-curable photopolymer (XD 4820™, Huntsman) is then finally applied by spin-coating, and the first L0 half-disc is adhesively bonded thereto with its semi-transparent layer in contact with the adhesive. On a commercial test apparatus (ODU-1000™, Pulstec Japan), using a laser diode of wavelength 405 nm and a numerical aperture of 0.65, marks are written into the active layer at speeds of 6.61 $m \cdot s^{-1}$. Read out is then performed on the same apparatus by applying a read power of 0.6 mW and the following dynamic parameters are determined: Optimum recording power, reflectivity, I11 / I11H modulation and CNR signal-to-noise ratio.

Recording Layer	Groove depth [nm]	Best Optical Density	Optimum Laser power [mW]	Reflectivity R11H [%]	Modulation I11/I11H	CNR [dB]	Multi-track PRSNR
L0	63	0.56	8.0	4.5	0.36	42.3	
L1	20	0.45	12.0	4.6	0.40	45.5	

Example 147: It is proceeded analogously to example 146, with the difference that the inner recording layer (L1) consists of the compound according to example 36 and the outer recording layer (L0) consists of the compound of the formula:



The disc is prepared following the “2P” manufacturing method. The L0 half-disc is made essentially as described in example 146, with the exception that a 10 nm thick silver layer is applied to the recording layer by sputtering, thus forming a semi-

transparent layer. Then an adhesive layer of a UV-curable photopolymer (XD 4820™, Huntsman) is applied by spin-coating, and before curing the adhesive a transparent stamper made of Zeonor™ (Zeon Corp., Japan) is stuck to the adhesive. After curing the adhesive under UV light, the transparent stamper is removed from the disc, leaving the adhesive layer with a grooved structure (groove depth 60 nm, groove width 220 nm, track pitch 400 nm). 1.4 g of the compound according to example 36 is dissolved in 100 ml of 2,2,3,3-tetrafluoropropanol and filtered through a 0.2 μm Teflon™ filter. The dye solution is applied by spin-coating onto the silver layer, forming a uniform, amorphous solid layer having an optical density of 0.4. Drying is carried out in a circulating-air oven at 70°C for 20 minutes. In a vacuum-coating apparatus, a 120 nm thick silver layer is then applied to the second recording layer by sputtering. An adhesive layer of a UV-curable photopolymer (XD 4820™, Huntsman) is then finally applied by spin-coating, and a dummy polycarbonate half-disc is adhesively bonded thereto. Following the same testing procedure as described in example 146, the following dynamic parameters are determined: Optimum recording power, Reflectivity R11H, I11 / I11H, modulation and PRSNR.

Recording Layer	Groove depth [nm]	Best Optical Density	Optimum Laser power [mW]	Reflectivity R11H [%]	Modulation I11/I11H	CNR [dB]	Multi-track PRSNR
L0	75	0.5	11.0	3.0	0.51		8.0
L1	60	0.4	12.0	2.7	0.22		

Examples 148 – 213: It is proceeded analogously to example 146, with the difference that the product according to example 1 is replaced by the products according to examples 3 – 5, 7 – 9, 12 – 14 and 17 – 73, respectively.

Examples 214 – 279: It is proceeded analogously to example 147, with the difference that the product according to example 36 is replaced by the products according to examples 1, 3 – 5, 7 – 9, 12 – 14, 17 – 35 and 37 – 73, respectively.

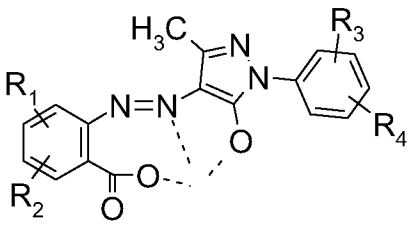
Claims:

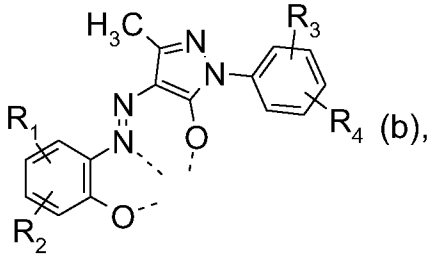
1. An optical recording medium suitable for optical recording with a laser of wavelength below 600 nm, preferably from 350 to 500 nm, comprising a grooved substrate, a reflecting layer and a recording track of width from 100 to 400 nm, preferably from 150 to 250 nm, depth from 10 to 200 nm, preferably from 20 to 90 nm, and pitch from 250 to 430 nm, preferably from 310 to 400 nm, wherein the recording track comprises a compound of formula

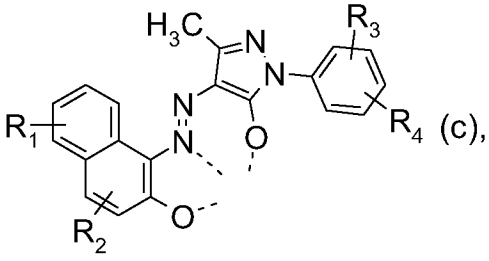
$$[(L_1)M_1(L_2)]^{m-}\ Z_1^{n+}\ (I),$$

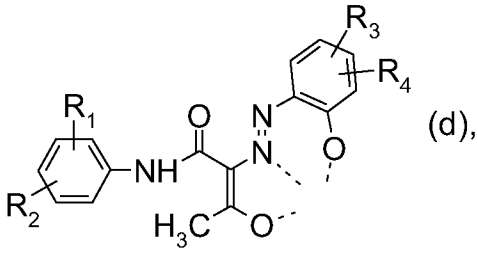
or a mesomeric or tautomeric form thereof, wherein

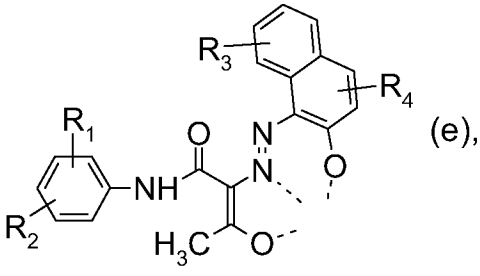
L_1 and L_2 independently of one another are ligands of the formula

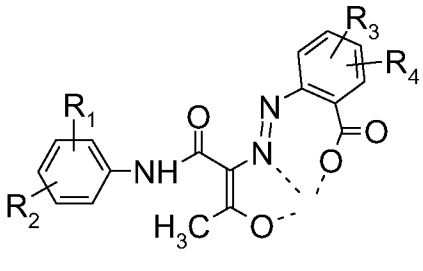

(a),

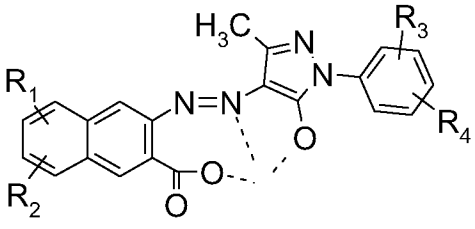

(b),


(c),


(d),


(e),

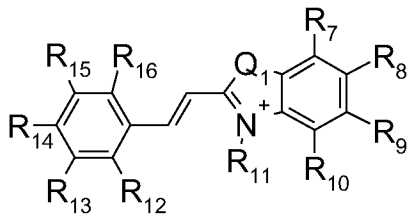
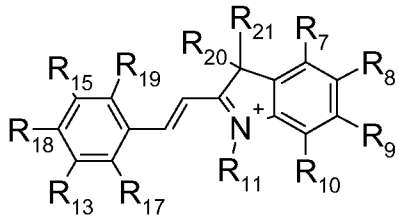
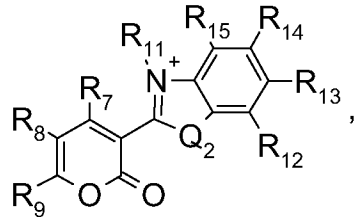
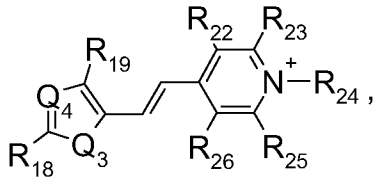
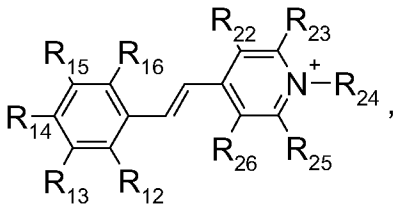
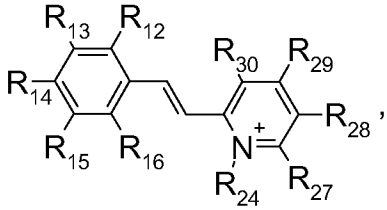
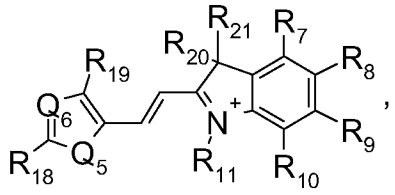
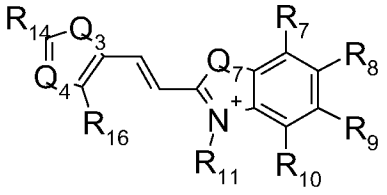
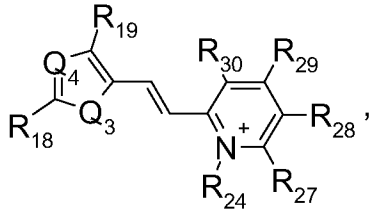
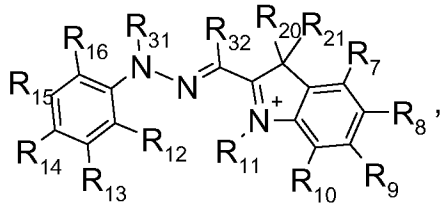
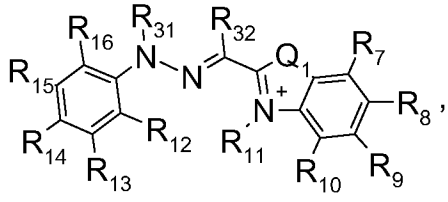
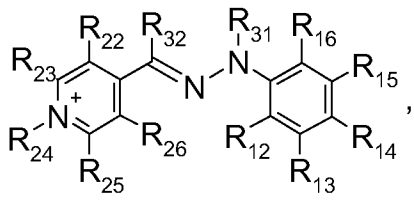
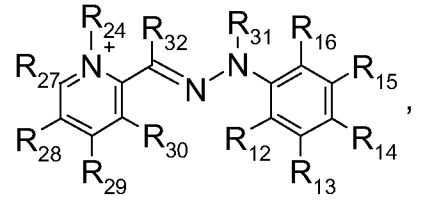
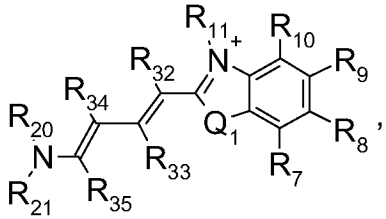
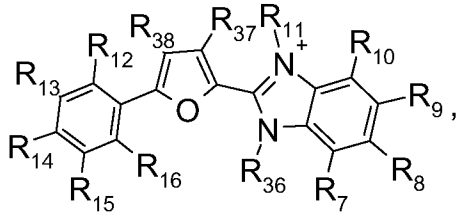
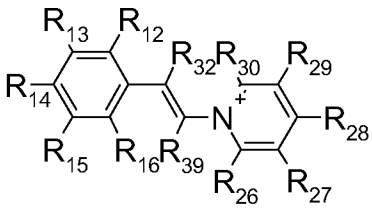
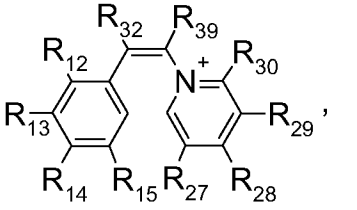

(f) or

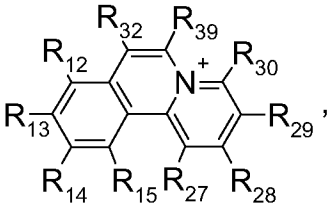
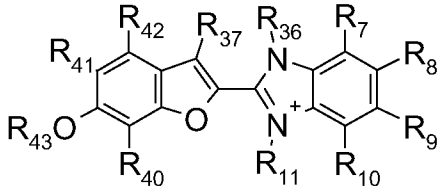
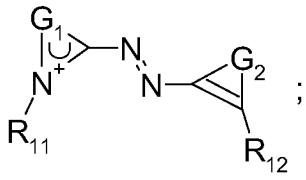

(g);

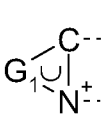
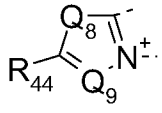
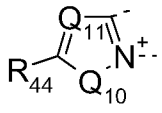
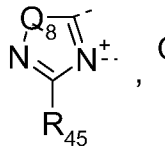
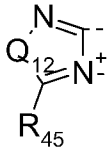
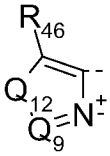
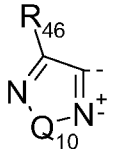
M_1 is a metal cation in the oxidation state +3, a hydroxy or halogeno metal group wherein the metal is in the oxidation state +4, or an oxo metal group wherein the metal is in the oxidation state +5, most preferred Cr^{3+} or Co^{3+};

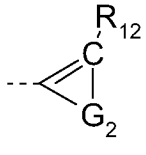
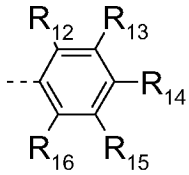
m is the integer 1 ; n is an integer 1, 2 or 3 ;

Z_1 is a cation selected from the group consisting of cations of the formulae


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 ,  and  ;

 is  ,  ,  ,  ,  or  ;

 is  or C_2-C_8heteroaryl unsubstituted or mono- or poly-substituted by R_{47}, R_{48}, R_{49} and/or R_{50};

Q_1 and Q_7 are each independently of the other O or S; Q_2 is O, S, $CR_{20}R_{21}$ or NR_{36}; Q_3 and Q_5 are each independently of the other O, S or NR_{51}; Q_4 is N or CR_{52}; Q_6 is N, or is CR_{12} when Q_5 is O or S; Q_8, Q_{10} and Q_{12} are each independently of the other $CR_{53}R_{54}$, O, S or NR_{51}; Q_9 and Q_{11} are each independently of the other CR_{55} or N;

R_1, R_2, R_3 and R_4 independently of one another are hydrogen, halogen, R_5, NO_2, NR_5R_6, NHCO–R_5, NHCOO–R_5, SO_2–R_5, SO_2NH_2, SO_2NH–R_5, $SO_2NR_5R_6$, SO_3^- or SO_3H;

R_5 and R_6 independently of one another are unsubstituted or hydroxyl-, halo- or C_1-C_6alkoxy-substituted C_1-C_{12}alkyl or C_6-C_{10}aryl;

R_7, R_8, R_9, R_{10}, R_{12}, R_{13}, R_{14}, R_{15}, R_{16}, R_{40}, R_{41}, R_{42}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, R_{49}, R_{50}, R_{52} and R_{55} are each independently of the other H, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{59}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, $OSiR_{51}R_{58}R_{61}$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$, SO_2R_{51}, $SO_2NR_{59}R_{60}$, SO_3R_{59}; C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen,

OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59}; or C_7-C_{11}aralkyl, C_6-C_{10}aryl or C_1-C_8heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51}, NO_2, CN and/or $COOC_1$-C_4alkyl;

R_{11} and R_{36} are independently of each other C_1-C_{20}alkyl, C_3-C_{12}cycloalkyl, C_1-C_{12}heterocycloalkyl, C_2-C_{20}alkenyl, C_3-C_{12}cycloalkenyl, C_4-C_{12}heterocycloalkenyl, C_2-C_{20}alkynyl, C_7-C_{18}aralkyl, C_1-C_9heteroaryl, C_2-C_{17}heteroaralkyl, C_6-C_{12}aryl or C_1-C_{12}alkyl interrupted by from one to five non-successive oxygen and/or sulfur atoms and/or by from one to five identical or different groups NR_{51}, each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{59}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, $OSiR_{51}R_{58}R_{61}$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$, SO_2R_{51}, $SO_2NR_{59}R_{60}$, SO_3R_{59};

R_{17}, R_{18} and R_{19} are each independently of the other H, halogen, OR_{56}, SR_{56}, $OSiR_{51}R_{58}R_{61}$, $CR_{51}OR_{67}OR_{68}$; C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59}; or C_7-C_{11}aralkyl, C_6-C_{10}aryl or C_1-C_8heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51} and/or $COOC_1$-C_4alkyl;

R_{20} and R_{21} are each independently of the other C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_7-C_{12}aralkyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59};

or R_{20} and R_{21} are together C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen, one to five non-successive carbon atoms of which can be replaced by oxygen and/or sulfur atoms and/or by identical or different groups NR_{51}, C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen

being each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59};

R_{22}, R_{23}, R_{25}, R_{26}, R_{27}, R_{28}, R_{29} and R_{30} are each independently of the other H, halogen, COR_{51}, NO_2, CN, SO_3R_{59}; or C_1-C_6alkyl, C_6-C_{12}aryl, C_7-C_{12}aralkyl each unsubstituted or mono- or poly-substituted by halogen, C_1-C_8alkyl and/or SO_3R_{59};

R_{24} is halogen, $COOR_{56}$, $CONR_{59}R_{60}$; or C_1-C_{20}alkyl, C_7-C_{18}aralkyl each unsubstituted or mono- or poly-substituted by halogen, C_1-C_8alkyl, COR_{51}, $COOR_{56}$, $CONR_{59}R_{60}$, OR_{56}, CN and/or SO_3R_{31};

R_{31} is C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_7-C_{12}aralkyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, $NR_{51}COR_{58}$, $NR_{51}COOR_{56}$, $NR_{51}CONR_{59}R_{60}$, $NR_{51}CN$, COR_{51}, $CR_{51}OR_{67}OR_{68}$, NO_2, CN, $COOR_{56}$, $CONR_{59}R_{60}$ and/or SO_2R_{59};

or R_{16} and R_{31} are together with the nitrogen and the carbon atoms joining them together a 5- or a 6-membered ring;

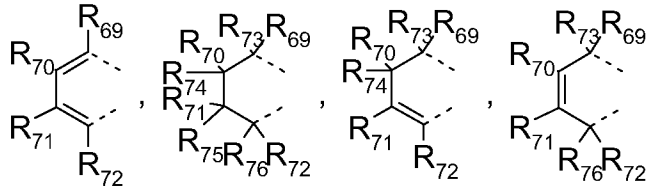
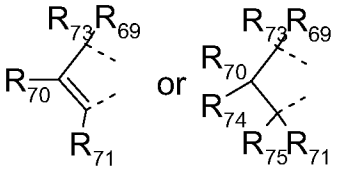
R_{32}, R_{33}, R_{34} and R_{35} are each independently of the other H, CH_3 or C_2H_5 each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62} or $NR_{43}R_{63}$;

R_{37} and R_{38} are each independently of the other H; C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62} or $NR_{43}R_{63}$; or C_7-C_{11}aralkyl, C_6-C_{10}aryl or C_1-C_8heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{62}, SR_{62}, $NR_{43}R_{63}$, COR_{63}, NO_2, CN and/or $COOC_1$-C_4alkyl;

R_{39} is COR_{43}, $COOR_{43}$, $CONR_{64}R_{65}$, CN, $SO_2NR_{64}R_{65}$, SO_2R_{64} or SO_3R_{31}; or is C_1-C_4alkyl mono- or poly-substituted by halogen;

R_{43}, R_{57}, R_{59}, R_{60}, R_{64} and R_{65} are each independently of the others H; C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5heterocycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{66}, SR_{66}, $NR_{61}R_{63}$, CN and/or $COOR_{63}$; or C_6-C_{10}aryl, C_7-C_{11}aralkyl or C_1-C_5heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, OR_{66}, SR_{66}, $NR_{61}R_{63}$, COR_{63}, $CR_{63}OR_{67}OR_{68}$, NO_2, CN and/or $COOR_{61}$;

or $NR_{64}R_{65}$ and/or $NR_{59}R_{60}$ is a five- or six-membered heterocycle which may contain a further N or O atom and which can be mono- or poly-substituted by methyl and/or ethyl;

or one or more pairs R_7 and R_8, R_8 and R_9, R_9 and R_{10}, R_{11} and R_{32}, R_{12} and R_{13}, R_{12} and R_{18}, R_{12} and R_{32}, R_{13} and R_{14}, R_{13} and R_{17}, R_{13} and R_{18}, R_{14} and R_{15}, R_{14} and R_{52}, R_{15} and R_{16}, R_{15} and R_{18}, R_{15} and R_{19}, R_{16} and R_{31}, R_{16} and R_{52}, R_{18} and R_{52}, R_{19} and R_{52}, R_{20} and R_{34}, R_{21} and R_{35}, R_{22} and R_{23}, R_{25} and R_{26}, R_{26} and R_{27}, R_{27} and R_{28}, R_{28} and R_{29}, R_{29} and R_{30}, R_{32} and R_{34}, R_{33} and R_{35}, R_{41} and R_{42}, R_{44} and R_{55} and/or R_{47} and R_{48}, are independently from all other of these pairs together a bivalent group of the formula  ,  or , thus forming a benzene, cyclohexene, cyclohexadiene, cyclopentadiene or cyclopentene ring with the two adjacent carbons to which they are bound;

R_{51}, R_{58}, R_{61} and R_{63} are each independently of the others hydrogen, benzyl; or C_1-C_4alkyl, C_2-C_4alkenyl, C_2-C_4alkynyl, $[C_2$-C_3alkylen-O-$]_k$-R_{77} or $[C_2$-C_3alkylen-NR_{78}-$]_k$-R_{77} each unsubstituted or mono- or poly-substituted by halogen;

or $NR_{43}R_{63}$, $NR_{51}R_{57}$, $SiR_{51}R_{58}$ and/or $NR_{61}R_{63}$ is a five- or six-membered heterocycle which may contain a further N or O atom and which can be mono- or

poly-substituted by methyl and/or ethyl;

R_{67} and R_{68} are each independently of the others benzyl; or C_1-C_4alkyl, C_2-C_4alkenyl, C_2-C_4alkynyl, $[C_2$-C_3alkylen-O-$]_k$-R_{77} or $[C_2$-C_3alkylen-NR_{78}-$]_k$-R_{77} each unsubstituted or mono- or poly-substituted by halogen;

k is an integer 1, 2, 3 or 4;

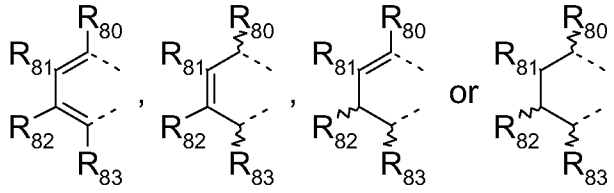
R_{53} and R_{54} are each independently of the other C_1-C_{12}alkyl, C_2-C_{12}alkenyl, C_2-C_{12}alkynyl, C_7-C_{12}aralkyl, C_3-C_{12}cycloalkyl, C_3-C_{12}cycloalkenyl or C_2-C_{11}hetero-cycloalkyl each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62}, $NR_{43}R_{63}$, $NR_{63}COR_{61}$, $NR_{63}COOR_{62}$, $NR_{63}CONR_{64}R_{65}$, $NR_{63}CN$, COR_{63}, $CR_{63}OR_{68}OR_{67}$, NO_2, CN, $COOR_{62}$, $CONR_{64}R_{65}$ and/or SO_2R_{64};

or R_{53} and R_{54} are together as a pair C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen, one to five non-successive carbon atoms of which can be replaced by oxygen and/or sulfur atoms and/or by identical or different groups NR_{63}, C_2-C_{12}alkylen, C_2-C_{12}alkenylen, C_2-C_{12}cycloalkylen or C_2-C_{12}cycloalkenylen being each unsubstituted or mono- or poly-substituted by halogen, OR_{62}, SR_{62}, $NR_{43}R_{63}$, $NR_{63}COR_{61}$, $NR_{63}COOR_{62}$, $NR_{63}CONR_{64}R_{65}$, $NR_{63}CN$, COR_{63}, $CR_{63}OR_{67}OR_{68}$, NO_2, CN, $COOR_{62}$, $CONR_{64}R_{65}$ and/or SO_2R_{64};

each R_{56} or R_{62}, independently of any other R_{56} or R_{62}, is R_{43} or R_{79};

each R_{66}, independently of any other R_{66}, is independently of the others C_1-C_6alkyl, C_2-C_6alkenyl, C_2-C_6alkynyl, C_3-C_6cycloalkyl, C_3-C_6cycloalkenyl or C_2-C_5hetero-cycloalkyl each unsubstituted or mono- or poly-substituted by halogen, $NR_{61}R_{63}$, CN and/or $COOR_{63}$; or C_6-C_{10}aryl, C_7-C_{11}aralkyl or C_1-C_5heteroaryl each unsubstituted or mono- or poly-substituted by C_1-C_4alkyl, halogen, $NR_{61}R_{63}$, COR_{63}, $CR_{63}OR_{67}OR_{68}$, NO_2, CN and/or $COOR_{61}$;

R_{69}, R_{70}, R_{71} and R_{72} are each independently of the other H, C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51}, NO_2, CN or $COOC_1$-C_4alkyl;

or one or more pairs R_{69} and R_{70}, R_{70} and R_{71} and/or R_{71} and R_{72} are independently from both other pairs together  , thus

forming a benzene or a partially or fully saturated 6-membered ring with the two adjacent carbons to which they are bound;

R_{73}, R_{74}, R_{75} and R_{76} are each independently of the other H, C_1-C_4alkyl, halogen, OR_{56} or SR_{56}, it being possible R_{69} to form a 3-, 4-, 5- or 6-membered ring with R_{73}, R_{70} to form a 3-, 4-, 5- or 6-membered ring with R_{74}, R_{71} to form a 3-, 4-, 5- or 6-membered ring with R_{76} or R_{72} to form a 3-, 4-, 5- or 6-membered ring with R_{75}; or R_{69} and R_{73}, R_{70} and R_{74}, R_{71} and R_{75} or R_{72} and R_{76} are together NR_{51}, O or S;

R_{77} and R_{78} are each independently of the other methyl, ethyl, vinyl and/or allyl;

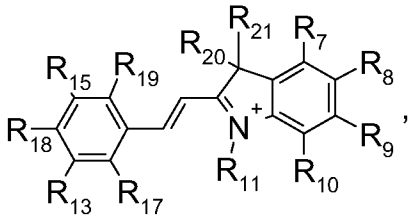
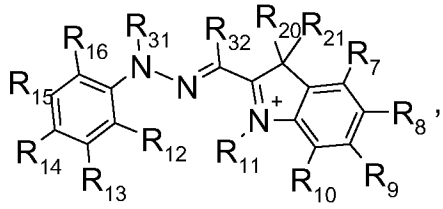
R_{79} is COR_{43}, $COOR_{43}$, $CONR_{64}R_{65}$, CN, $SO_2NR_{64}R_{65}$ or SO_2R_{64};

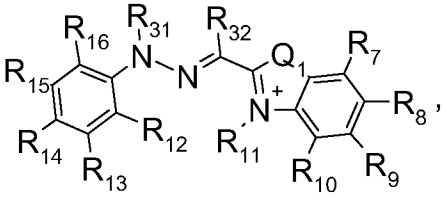
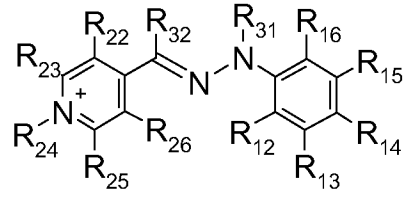
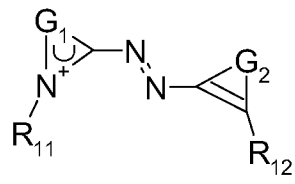
R_{80}, R_{81}, R_{82} and R_{83} are each independently of the other H, C_1-C_4alkyl, halogen, OR_{56}, SR_{56}, $NR_{51}R_{57}$, COR_{51}, NO_2, CN or $COOC_1$-C_4alkyl; and

it being possible once or more times radicals of the same or different substituents each selected from the group consisting of R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, R_{16}, R_{17}, R_{18}, R_{19}, R_{20}, R_{21}, R_{22}, R_{23}, R_{24}, R_{25}, R_{26}, R_{27}, R_{28}, R_{29}, R_{30}, R_{31}, R_{32}, R_{33}, R_{34}, R_{35}, R_{36}, R_{40}, R_{41}, R_{42}, R_{43}, R_{44}, R_{45}, R_{46}, R_{47}, R_{48}, R_{49}, R_{50}, R_{51}, R_{53}, R_{55}, R_{56}, R_{57}, R_{58}, R_{59}, R_{62}, R_{63}, R_{64}, R_{66}, R_{67}, R_{68}, R_{69}, R_{70}, R_{71}, R_{72}, R_{77}, R_{79}, R_{80}, R_{81}, R_{82} and R_{83} to be bonded to one another in pairs by way of a direct bond or an -O-, -S- or -N(R_{78})- bridge, optionally forming a compound comprising two or three identical or different moieties of formula (I).

2. Optical recording medium according to claim 1, wherein L_1 and L_2 are identical or different ligands of the formula (b), (c), (d) and (e).

3. Optical recording medium according to claim 1 or 2, wherein Z_1^{n+} is of the

formula  ,  ,

 ,  or 

and n is 1 or 2.

4. Optical recording medium according to claim 1, 2 or 3, wherein M_1 is Co^{3+} or Cr^{3+}.

5. A compound of formula (I) according to claim 1, 2, 3 or 4.

6. A process for the preparation of a thin layer on a substrate, wherein a solution of a compound of formula (I) according to claim 1, 2, 3 or 4 in a volatile solvent is applied onto the rotating substrate and the solvent is then evaporated.

7. Use of a compound of formula (I) according to claim 1, 2, 3 or 4 for the preparation of a medium for optical recording with a laser of wavelength below 600 nm, preferably from 350 to 500 nm.

8. A process for the optical recording or playback of information, wherein a laser beam of wavelength below 600 nm, preferably from 350 to 500 nm, especially from 350 to 450 nm, is focussed onto the recording track of a recording medium comprising a compound of formula (I) according to claim 1, 2, 3 or 4.

9. An optical recording medium suitable for optical recording with a laser of wavelength below 600 nm, preferably from 350 to 500 nm, comprising a grooved substrate, a reflecting layer and at least two recording tracks, wherein at least one recording track comprises a compound of formula $[(L_1)M_1(L_2)]^{m-}$ Z_1^{n+} (I) according to claim 1, 2, 3 or 4, or a mesomeric or tautomeric form thereof.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2007/054027

A. CLASSIFICATION OF SUBJECT MATTER
INV. G11B7/246 G11B7/249 C09B45/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G11B C09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, CHEM ABS Data, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) & JP 2005 305836 A (TDK CORP), 4 November 2005 (2005-11-04) abstract; compounds A21-23, A25, A27	1-9
A	EP 1 170 339 A (KABUSHIKI KAISHA HAYASHIBARA SEIBUTSU KAGAKU KENKYUJO) 9 January 2002 (2002-01-09) paragraph [0049]; compound 7	1-9
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A	WO 98/32802 A (CIBA SPECIALTY CHEMICALS HOLDING INC) 30 July 1998 (1998-07-30) compound XV	1-9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 July 2007	16/07/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Stabel, Andreas

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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