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(54) Benævnelse: **HIDTIL UKENDTE BIS-INDOLYLMETHANER, FREMGANGSMÅDE TIL FREMSTILLING HERAF OG ANVENDELSER DERAF**

(56) Fremdragne publikationer:
DAMODIRAN M ET AL: "Regioselective synthesis and biological evaluation of bis(indolyl)methane derivatized 1,4-disubstituted 1,2,3-bistriazoles as anti-infective agents", BIOORGANIC & MEDICINAL CHEMISTRY LETTERS, PERGAMON, AMSTERDAM, NL, vol. 19, no. 13, 1 July 2009 (2009-07-01), pages 3611-3614, XP026155119, ISSN: 0960-894X, DOI: 10.1016/J.BMCL.2009.04.131 [retrieved on 2009-05-03]
SHARMA D. K. ET AL.: "A new class of bactericidal agents against S. aureus, MRSA and VRE derived from bisindolylmethane", MEDICINAL CHEMISTRY RESEARCH, vol. 23, no. 4, 4 September 2013 (2013-09-04), pages 1643-1653, XP002752541,

DESCRIPTION

[0001] The present invention relates to novel bis-indolylmethanes, a process for their preparation and their use in the preparation of technical textiles and PPE's (Personal Protective Equipments), namely in the preparation of UV-protective and anti-infective textiles and garments.

Technical background

[0002] Ultraviolet radiation (both UVA and UVB) contribute to sunburn, skin ageing, eye damage and skin cancer. It is therefore commonly acknowledged the importance to avoid excessive exposure to the sun and to protect by applying sunscreens to the skin.

[0003] Recently sun-protecting clothing is becoming popular, said clothing being called PPEs (Personal Protective Equipments).

[0004] In some cases, PPEs are also able to protect the body from infections, creating a barrier between the wearer and germs and are especially useful for health-care or biological laboratory workers.

[0005] Indeed, PPEs are designed to reduce the exposure to hazards, either being them caused by sun or other UV source exposure or by bacteria, fungi, virus and the like.

[0006] There is a need to develop improved fabrics for the manufacture of PPEs which provide a more effective barrier between the wearer and the environment.

Scope of the invention

[0007] It is a scope of the invention to provide new compounds bearing bis-indolyl moiety.

[0008] It is a further scope of the invention to provide new compounds which are able to impart a textile sun-protective and anti-infective effect.

[0009] It is a further scope of the invention to provide garments and PPEs which are endowed with sun-protective and anti-infective effect and which are made from the new compounds of the invention.

[0010] It is another scope of the invention to provide a process for the preparation of the new compounds of the invention.

[0011] These and further scopes will be achieved by the subject-matter of the invention, as it will be herein disclosed.

Brief description of the Drawings

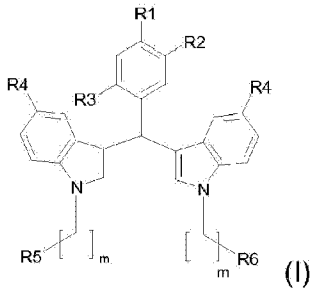
[0012]

Figures 1 to 24 show the analytical data of the compounds of the examples.

Figures 25 to 28 show the results of the UPF test on a non-treated and treated fabrics.

Description of the invention

[0013] According to one of its aspects, the present invention relates to new compounds of formula (I)



(I)

wherein

R_1

is selected from hydrogen, a halogen atom, a non-substituted, saturated or unsaturated, linear or branched, acyclic C1-C10 alkyl group; and a non-substituted, saturated or unsaturated, linear or branched, acyclic C1-C10 alkoxy group; when R2 and R3 are H;

R_2

is selected from hydrogen, a non-substituted, saturated or unsaturated, linear or branched, acyclic C1-C10 alkyl group, and a non-substituted, saturated or unsaturated, linear or branched, acyclic C1-C10 alkoxy group; when R1 is H and R3 are alkyl or alkoxy groups as above defined;

R_3

is selected from hydrogen, a halogen atom, a non-substituted, saturated or unsaturated, linear or branched, acyclic C1-C10 alkyl group, and a non-substituted, saturated or unsaturated, linear or branched, acyclic C1-C10 alkoxy group; when R1 is H and R3 are halogen, alkyl or alkoxy as above defined;

R_4

is selected from a non-substituted, saturated or unsaturated, linear or branched, acyclic

C1-C10 alkyl group and a non-substituted, saturated or unsaturated, linear or branched, acyclic C1-C10 alkoxy group;

R_5

is selected from a halogen atom, polyvinylalcohol; polyvinylamine and a cellulose-polymer;

R_6

is selected from a halogen atom; polyvinylalcohol; polyvinylamine and a cellulose-polymer;

m

is from 3 to 5.

[0014] Preferably the alkyl group is a linear C1-C4 alkyl group. According to a preferred embodiment, the alkyl group is a methyl group.

[0015] Preferably the alkoxy group is a linear C1-C4 alkoxy group. According to a preferred embodiment, the alkoxy group is a methoxy group.

[0016] The term "halogen" here represents chlorine, bromine, iodine and fluorine. Chlorine and bromine are preferred.

[0017] Polyvinylalcohol herein defines a residue of a polyvinylalcohol, which is bound to the alkyl chain by an oxygen atom. A preferred PVA molecular weight is approx.100,000-130,000 g/mol with a Pw: 2,700 (polymerisation degree) and hydrolysis ratio: 86-88%. PVA as above is commercially available.

[0018] Preferred embodiments are the following:

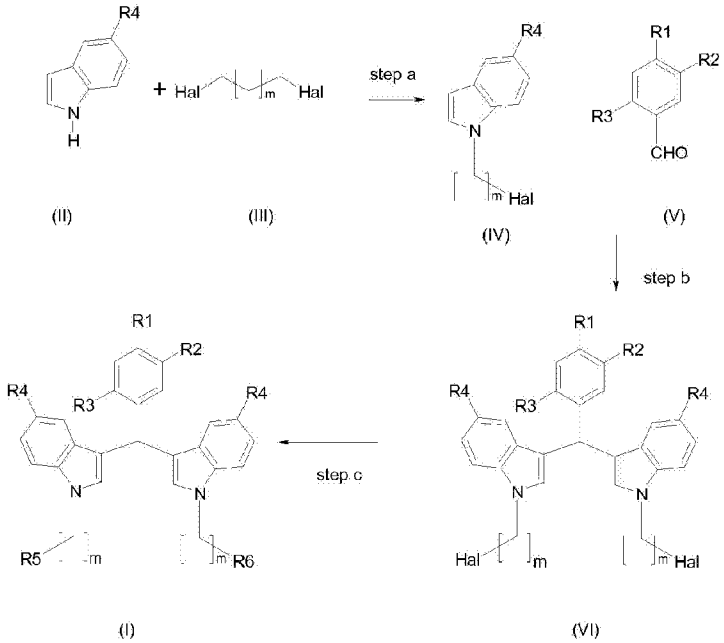
- R_2 is hydrogen and R_1 and R_3 are both halogen, advantageously both chlorine;
- R_1 is hydrogen and R_2 and R_3 are both alkoxy groups advantageously both a methoxy group;
- R_2 and R_3 are both hydrogen and R_1 is halogen, advantageously fluorine;
- R_4 are a methyl group;
- R_5 and R_6 are both halogen, advantageously bromine;
- R_5 is bromine and R_6 is polyvinylalcohol;
- m is 4.

[0019] Particularly preferred are compounds of formula (I) wherein

- R_2 is hydrogen; R_1 and R_3 are both chlorine; R_4 and R_5 are both methyl groups; R_5 and R_6 are both bromine; m is 4;

- R_1 is hydrogen; R_2 and R_3 are both a methoxy group; R_4 is a methyl group; R_5 and R_6 are both bromine; m is 4;
- R_1 is fluorine; R_2 and R_3 are both hydrogen; R_4 is a methyl group; R_5 and R_6 are both bromine; m is 4;
- R_2 is hydrogen; R_1 and R_3 are both chlorine; R_4 is methyl groups; R_5 is bromine and R_6 is polyvinylalcol; m is 4;
- R_1 is hydrogen; R_2 and R_3 are both a methoxy group; R_4 is a methyl group; R_5 is bromine and R_6 is polyvinylalcol; m is 4;
- R_1 is fluorine; R_2 and R_3 are both hydrogen; R_4 is a methyl group; R_5 is bromine and R_6 is polyvinylalcol; m is 4;

[0020] The compounds of the invention may be prepared by a process according to the following Scheme



wherein R_1, R_2, R_3, R_4, R_5, R_6 and m are as above defined, Hal is a halogen atom, and m is from 1 to 3.

[0021] The above depicted process represents another subject-matter of the invention.

[0022] Compounds of formula (II) and (III) are known in the art or can be prepared by known methods.

[0023] In the process of the invention, a compound of formula (II) is reacted with the dihalo-alkylene (III) in an appropriate solvent, in the presence of a strong base.

[0024] Preferably, the solvent is selected from an alkanone, such as 2-butanone. However, organic solvents with similar polarity may also be used. Preferably, the base is a hydroxide,

such as an alkali-metal hydroxide, for instance KOH or NaOH.

[0025] Preferably the molar ratio compound (II)/compound (III)/base is approx. 1/4/2. It is advantageous to perform the reaction in an inert environment, such as under nitrogen or argon.

[0026] The temperature of the reaction is comprised between room temperature and the reflux temperature of the reaction mixture, preferably between 40 and 80°C, advantageously approx. 50-60°C.

[0027] The reaction is complete in few hours, about 1 to 6 hours. The skilled in the art is however able to follow the development of the reaction flow and finishing time, which can be determined, for instance, by using TLC (Thin Layer Chromatography) technique.

[0028] Compound of formula (IV) is isolated and, if necessary or desired, purified before being reacted with benzaldehyde of formula (V), preferably in a molar ratio of at least 2/1, in the presence of catalytic amounts of 1,3-dibromo-5,5-dimethylhidantoin (DBDMH). The reaction is preferably carried out without any solvent.

[0029] It is advantageous to perform the reaction in an inert environment, such as under nitrogen or argon.

[0030] The temperature of the reaction is comprised between room temperature and the reflux temperature of the reaction mixture, preferably between 40 and 80°C, advantageously approx. 50-60°C.

[0031] The reaction is complete in few hours, about 1 to 6 hours. The skilled in the art is however able to follow the development of the reaction by using conventional methods, such as chromatographic techniques.

[0032] Compound of formula (VI) is isolated and, if necessary or desired, purified according to the known techniques. Compound (VI) corresponds to compound (I) when R_6 is halogen.

[0033] To prepare compound (I) wherein R_6 is selected from polyvinylalcohol; polyvinylamine and a cellulose-polymer, the following reaction may be carried out.

[0034] To a solution of polyvinylalcohol (PVA) or polyvinylamine or a cellulose-polymer, in a suitable solvent, such as dimethylformamide (DMF), in an inert atmosphere and heated at least 100°-120°C, a base, such as potassium carbonate (K_2CO_3), is added and the mixture is stirred for a few hours, such as 1 or 2 hours. To that mixture, compound (VI) is added and the reaction is stirred under chromatographic control, such as TLC, for a few hours, such as 2-4 hours. The solvent is evaporated and the desired compound (I) is isolated by filtration. Preferably, the mixture centrifuged before filtering. Detailed examples of the above reaction are provided in the experimental section of the present description.

[0035] Compounds of formula (I) may be used to impart sun-protective and anti-infective effect to textiles.

[0036] The expressions "sun-protective effect" means that the textile and the garments made therewith are able to protect the wearer from UV radiation.

[0037] The expression "anti-infective effect" means that the textile and the garments are able to protect the body from infections, creating a barrier between the wearer and germs, such as bacteria, especially Gram (+) bacteria and/or fungi and/or virus and/or protozoa and/or helminths.

[0038] Indeed, it was found out that coating fabrics with the compounds of the invention increases the UPF (Ultraviolet Protection Factor) label values and, also, confers to the fabric anti-microbial effects, especially anti-bacterial effects, particularly Gram (+) bacteria.

[0039] This is a valuable technical outcome that allows the treated fabrics to be used in the manufacture of, i.a. PPEs.

[0040] The use of compounds of formula (I) in the textile field, in the preparation of sun-protective and anti-infective fabrics and in the manufacture of PPEs is also a subject-matter of the invention, as well as fabrics, clothing and PPEs treated, especially coated, with the compounds of formula (I).

[0041] It is another subject-matter of the invention a method to make fabrics sun-protective and anti-infective fabrics which comprises treating, especially coating, said fabrics with the compounds of formula (I).

[0042] These fabrics may be obtained by dissolving the compounds of the invention in a suitable solvent, such as for instance dichloromethane and the solution may be added in to a conventional printing paste and then applied to the fabrics.

[0043] The terms "treat" or "treating" mean that fabrics or clothing or the like are coated of soaked with the compound of the invention.

[0044] These fabrics may be obtained by dissolving the compounds of the invention in a suitable solvent, i.e in a solvent which is able to dissolve compounds of formula (I), such as for instance dichloromethane, and the solution may be added in to a conventional printing paste and then applied to the fabrics. The flat bed screen method for printing application may be carried out, wherein acrylic and modified polymeric resins, as well as conventional crosslinkers may be used for printing paste. The fabrics may then preferably be cured, for instance at 130°C for 3-5 minutes.

[0045] Any kind of fabrics can be coated with the compounds of the invention, including

woven, knotted and non-woven fabrics.

[0046] Preferably, the fabrics are cotton fabrics, advantageously a 100% cotton fabrics.

[0047] The fabrics may also be denim.

[0048] In order to determine if the UV radiation blocked or transmitted by textile fabrics, the known method AATCC 183 was followed. Details of the method are given in the experimental section of the description.

[0049] As it can be seen in the experimental section, fabrics treated with the compounds of the invention showed surprisingly exceptional UPFs, all of them being well above the UPF value limit to be included in the "Excellent UV-protection category", i.e. UPF 40.

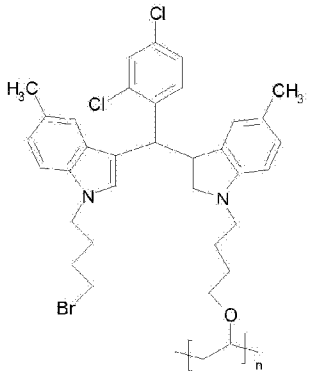
[0050] In order to determine if the antimicrobic activity of the textile fabrics, Washing Standart: BS EN ISO 6330 5A and Antibacterial Test Standart: AATCC 147:2011 were followed. Details of the method are given in the experimental section of the description.

Experimental Section

[0051] Analytical Spectra of the synthesized compounds are given in the figures enclosed.

Example 1

[0052]



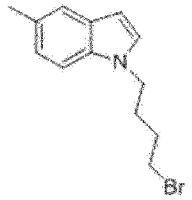
[0053] 5-methylindole and 1,4-dibromobutane are reacted in 2-butanone in the presence of KOH (molar ratio 5-methylindole/1,4-dibromobutane/KOH= 1/4/2) at 55°C, under N_2, for 3 hours. The intermediate compound (IV) is purified by column chromatography using silica gel as solid phase and 1/10 : ethyl acetate/n-hexane as the eluent system. The purified intermediate is reacted with 2,4-dichlorobenzaldehyde (2/1 molar ratio) in the presence of

catalytic amounts of 1,3-dibromo-5,5-dimetilhidantoin (DBDMH), at 55°C, under N_2 atmosphere for 2 hours to obtain the intermediate compound (VI) with 67% yield. The intermediate is purified by column chromatography using silica gel as solid phase and 1/15: ethyl acetate/n-hexane as the eluent system. PVA (molecular weight is approx.100,000-130,000 g/mol with a Pw: 2,700, hydrolysis ratio: 86-88%) is dissolved in dimethylformamide (DMF)(60 mg/3mL) at 120°C, under N_2 at the reflux temperature. After the addition of 70 mg K_2CO_3, the reaction mixture stirred up for 1 hour. Then, the intermediate compound (V) (100 mg/2mL DMF) is added to the mixture. The reaction ended, with TLC control, in 3 hours. DMF is removed, the reaction mixture is centrifugated and sedimented polymers filtered and dried in a drying oven at 45°C, to yield 47 % of the title compound.

Analytical data

Intermediate Compound

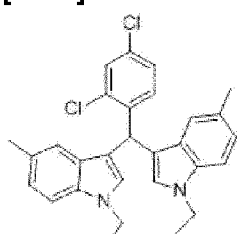
[0054]

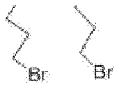


[0055] FTIR (ATR): v= 3032 and 3011 (aromatic, =CH streching), 2918 ve 2851 (aliphatic, CH streching), 1673 (C=C streching), 1488, 1445 ve 1355 (aliphatic, intraplanar CH bending) cm-1.
1H NMR (CDCl3, 500 MHz): δ= 1.72 (p, J= 6.62 Hz, 2H, CH2), 1.88 (p, J= 6.9 Hz, 2H, CH2), 2.36 (s, 3H, CH3), 3.25 (t, J= 6.62 Hz, 2H, CH2), 4.02 (t, J= 6.62 Hz, 2H, CH2), 6.32 (d, J= 3.15 Hz, 1H, aromatic), 6.94 (d, J= 3.15 Hz, 2H, aromatic), 7.13 (d, J= 8.51 Hz, 1H, aromatic), 7.33 (s, 1H, aromatic) ppm.
GC-MS (EI, 70 eV): m/z= 265 (M+).

Compound

[0056]





[0057] White crystals; m.p. = 141-142 °C; R_f= 0.32 (1:5, ethyl acetate/n-hexane); efficiency: %55

FTIR (ATR): v= 3081 and 3012 (aromatic, =CH streching), 2927, 2874 and 2856 (aliphatic, CH streching), 1585 (C=C streching), 1463 ve 1359 (aliphatic intraplanar, CH bending), 1100 (C-N swing) cm^{-1}.

^{1}H NMR (DMSO-d_6, 500 MHz): δ= 1.64-1.80 (m, 8H, CH_2), 2.27 (s, 6H, CH_3), 3.47 (t, J= 6.62 Hz, 4H, CH_2), 4.10 (t, J= 6.62 Hz, 4H, CH_2), 6.05 (s, 1H, CH), 6.70 (s, 2H, Haromatic), 6.94 (d, J= 8.19 Hz, 2H, aromatic), 7.00 (s, 2H, Haromatic), 7.15 (d, J= 8.51 Hz, 1H, aromatic), 7.31 (dd, J= 2.20; 8.51 Hz, 1H, Haromatic), 7.35 (d, J= 8.19 Hz, 2H, Haromatic), 7.63 (s, 1H, Haromatic) ppm.

^{13}C NMR ($CDCl_3$, 125 MHz): δ= 21.14 (2xCH_3), 28.42 (2xCH_2), 34.52 (2xCH_2), 35.68 (CH), 44.41 (CH_2), 109.77 (=CH), 114.75 (Cq), 118.39 (2xCAr), 122.89 (2xCAr), 126.97 (Cq), 127.15 (Cq), 127.25 (CAr), 128.73 (CAr), 131.13 (CAr), 133.60 (Cq), 134.79 (Cq), 140.80 (Cq) ppm.

UV (λ_{max}, CH_2Cl_2) : 295 nm (c= 3.5x10^{-4}, A= 1.52, ε= 4x10^{-3}).

Compound of Example 1

[0058] Orange polymer, efficiency: %47

FTIR (ATR): v= 3348 (OH streching), 3026 (aromatic, =CH streching), 2930 ve 2874 (aliphatic CH streching), 1557 ve 1486 (C=C streching), 1367 (aliphatic, intramoleculer CH bending), 1165 (C-O streching), 1049 (C-N swing) cm-1.

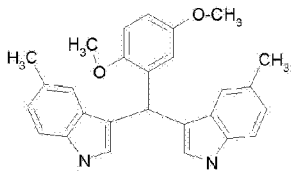
1H NMR (CDCl3, 500 MHz): 1H NMR (DMSO-d6, 500 MHz): δ= 1.41-1.47 (p, 4H, CH2), 1.78-1.84 (p, 4H, CH2), 1.93 (d, J= 18.91 Hz, 2H, CH2), 2.32 (s, 6H, CH3), 3.50 (t, J= 6.30 Hz, 4H, CH2), 3.97 (t, J= 6.62 Hz, 1H, CH), 4.07 (t, J= 6.93 Hz, 4H, CH2), 6.15 (s, 1H, CH), 6.53 (s, 2H, aromatic), 6.98 (d, J= 8.19 Hz, 2H, aromatic), 7.03 (s, 2H, aromatic), 7.17 (d, J= 4.72 Hz, 1H, aromatic), 7.27 (d, J= 8.51 Hz, 1H, aromatic), 7.35 (d, J= 1,57 Hz, 2H, aromatic) ppm.

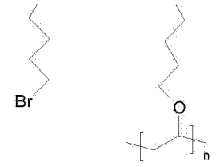
UV (λmax, CH2Cl2): 295 nm

See figures 1 to 10

Example 2

[0059]



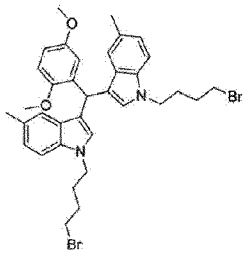


[0060] By operating as in Example 1 but using 2,5-dichlorobenzaldehyde instead of 2,4-dichlorobenzaldehyde, the title compound is obtained (yield 49%).

Analytical data

Compound

[0061]



[0062] White crystals; m.p.= 102 ° C; Rf= 0.12 (1:15, ethyl acetate /n-hexane); efficiency % 42.

FTIR (ATR): = 3022 and 3000 (aromatic, =CH streching), 2939, 2862 and 2831 (aliphatic, CH streching), 1616, 1588 and 1545 (C=C streching), 1489, 1450 and 1363(aliphatic, intraplanar CH bending), 1024 (C-N swing) cm-1.

1H NMR (DMSO-d6, 500 MHz): δ= 1.72-1.76 (p, 4H, CH2), 1.80-1.85 (p, 4H, CH2), 2.32 (s, 6H, CH3), 3.53 (t, J= 6.62 Hz, 4H, CH2), 3.62 (s, 3H, OCH3), 3.79 (s, 3H, OCH3), 4.15 (t, J= 6.62 Hz, 4H, CH2), 6.13 (s, 1H, CH), 6.66 (d, J= 2.83 Hz, 1H, aromatic), 6.76 (s, 2H, aromatic), 6.80 (dd, J= 3.15; 8.82 Hz, 1H, aromatic), 6.97 (d, J= 8.51 Hz, 2H, aromatic), 7.01 (d, J= 8.82 Hz, 1H, aromatic), 7.07 (s, 2H, aromatic), 7.37 (d, J= 8.51 Hz, 2H, aromatic), ppm.

13C NMR (CDCl3, 125 MHz): δ= 21.5 (2xCH3), 28.8 (2xCH2), 30.0 (2xCH2), 32.1 (CH), 33.1 (2xCH2), 45.3 (2xCH2), 55.5 (CH3), 56.6 (CH3), 108.8 (CAr), 110.6 (CAr), 111.8 (CAr), 116.5 CAr), 117.6 (Cq), 119.9 (CAr), 122.9 (CAr), 127.2 (CAr), 127.7 (Cq), 128.0 (Cq), 134.3 (Cq), 135.0 (Cq), 151.4 (Cq), 153.4 (Cq) ppm.

UV (λ_{max}, CH2Cl2): 285 nm (c= 2.4x10-4, A= 1.77, ε= 7.2x103).

Compound of Example 2

[0063] Orange polymer; efficiency % 47

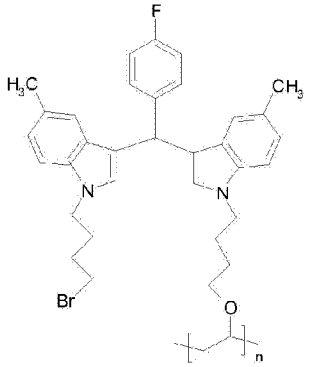
FTIR (ATR): = 3372 (OH streching), 3019 (aromatic, =CH streching), 2933 and 2871 (aliphatic, CH streching), 1661, 1589 ve 1547 (C=C streching), 1460 and 1366 (aliphatic intraplanar CH bending), 1211 (C-O streching), 1094 (C-N swing) cm-1.

UV (λ_{max}, CH2Cl2): 295 nm.

See Figures 11 to 17

Example 3

[0064]

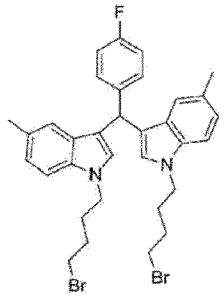


[0065] By operating as in Example 1 but using 4-fluorobenzaldehyde instead of 2,4-dichlorobenzaldehyde, the title compound is obtained (yield 45%).

Analytical data

Compound

[0066]



[0067] White crystals; m.p.= 118-119 o C; Rf= 0.22 (1:15, ethyl acetate /n-hexane); efficiency % 67.

FTIR (ATR): = 3028 ve 3009 (aromatic =CH streching), 2957, 2920 and 2854 (aliphatik, CH streching), 1602, 1549 and 1504 (C=C streching), 1485, 1453 and 1359 (aliphatick intraplanar CH streching), 1012 (C-N swing) cm-1.
1H NMR (DMSO-d6, 500 MHz): δ= 1.67-1.71 (p, 4H, CH2), 1.75-1.80 (p, 4H, CH2), 2.27 (s, 6H, CH3), 3.48 (t, J= 6.62 Hz, 4H, CH2), 4.10 (t, J= 6.62 Hz, 4H, CH2), 5.78 (s, 1H, CH), 6.75 (s, 2H, aromatic), 6.92 (d, J= 8.19 Hz, 2H, aromatic), 7.06 (s, 2H, aromatic), 7.10 (d, J= 8.82 Hz, 2H, aromatic), 7.31-7.34 (m, 4H, aromatic) ppm.
13C NMR (CDCl3, 125 MHz): δ= 21.5 (2xCH3), 28.8 (2xCH2), 30.0 (2xCH2), 32.1 (CH), 33.1 (2xCH2), 45.3 (2xCH2), 55.5 (CH3), 56.6 (CH3), 108.8 (CAr), 110.6 (CAr), 111.8 (CAr), 116.5 CAr), 117.6 (Cq), 119.9 (CAr), 122.9 (CAr), 127.2 (CAr), 127.7 (Cq), 128.0 (Cq), 134.3 (Cq), 135.0 (Cq), 151.4 (Cq), 153.4 (Cq) ppm.
UV (λ_{max}, CH2Cl2) : 300 nm (c= 2.2x10-4, A= 1.42, ε= 6.4x103).

Compound of Example 3

[0068] Brown polymer; efficiency % 52
FTIR (ATR): = 3340 (OH streching), 3043 (aromatic, =CH streching), 2932 and 2855 (aliphatic, CH streching), 1661, 1600 and 1504 (C=C streching), 1485 and 1363 (aliphatic intraplanar CH streching), 1217 (C-O streching), 1091 (C-N swing) cm-1.
UV (λ_{max}, DMSO): 295 nm.
See figures 18 to 24

Example 4

UPF test

AATCC 183 - 2004 Method

[0069] The transmission of ultraviolet radiation (UV-R) through a specimen is measured on a spectrophotometer at known wavelength intervals.

[0070] The ultraviolet protection factor (UPF) is computed as the ratio of the erythemally weighted ultraviolet radiation (UV-R) irradiance at the detector with no specimen to the erythemally weighted UV-R irradiance at the detector with a specimen present.

[0071] The erythemally weighted UV-R irradiance at the detector with no specimen present is equal to the summation between wavelength intervals of the measured spectral irradiance times the relative spectral effectiveness for the relevant erythemal action spectra times the UV-

R weighting function of the appropriate solar radiation spectrum times the appropriate wavelength interval.

[0072] The erythemally weighted UV-R irradiance at the detector with a specimen present is equal to the summation between wavelength intervals of the measured spectral irradiance times the relative spectral effectiveness for the relevant erythemal action spectrum times the spectral transmittance for the specimen times the wavelength interval.

[0073] The percent blocking of UVA and UVB radiation is also calculated as disclosed in AATCC 183 - 2004.

Results

[0074] Transmittance or Blocking of Erythemally Weighted Ultraviolet Radiation through Fabrics AATCC 183:2014

Conditioning

[0075] Prior to testing: 21 ± 1°C temperature and 65±2% relative humidity
At time of testing: 21°C temperature and 66% relative humidity
Ultraviolet protection value for label (According to ASTM D 6603-Unprepared Specimen): 1324
Protection Classification: Excellent UV-protection category to UPF Value 40 or greater.

[0076] The results are reported in the Figures, wherein

- Figure 25 shows the results on a sample of a non treated ecru woven fabric.
- Figure 26 shows the results on a sample of a light pink woven swatch treated with the compound of Example 1;
- Figure 27 shows the results on a sample of a light pink woven swatch treated with the compound of Example 2;
- Figure 28 shows the results on a sample of a pink woven swatch treated with the compound of Example 3;

[0077] As it can be seen from the data reported in the enclosed Figures, the treated samples showed excellent UV-protection, while the non-treated sample did not.

Example 5

Antimicrobial test

[0078] Antibacterial tests were carried out using Washing Standart: BS EN ISO 6330 5A, and Antibacterial Test Standart: AATCC 147:2011.

[0079] The results are reported herein below.

Inhibition zone mm mean value	Bacteria Growth	Assessment
>1	None	Good effect
0-1		
0		
0	Slight	Limit of Efficacy
0	Moderate heavy	Insufficient effect
0		

Test on a sample of a yellow printed woven fabric treated with the compound of Example 1

Inhibition Zone mm (1)	Bacteria Growth(2)
0	(-)
(-) no bacterial colonies directly under the treated sample in the contact area were observed. Inhibition zone exists - Good Effect (1) Width of clear zone of inhibition in mm (2) (-) no bacterial colonies directly under the treated sample	

Microorganism	*Staphylococcus aureus* ATCC 6538 Gram (+)
Size of sample	*25x50 mm*
Incubation Temperature	37°C±2°C
Incubation time	18-24 hrs
Number of washing	-
Washing method	-

Test on a sample of a pink woven fabric treated with the compound of Example 2

Inhibition Zone mm (1)	Bacteria Growth(2)
0	(-)
(-) no bacterial colonies directly under the treated sample in the contact area were observed. Inhibition zone exists - Good Effect (3) Width of clear zone of inhibition in mm (4) (-) no bacterial colonies directly under the treated sample	

Microorganism	*Staphylococcus aureus* ATCC 6538 Gram (+)
Size of sample	*25x50 mm*

Microorganism	*Staphylococcus aureus* ATCC 6538 Gram (+)
Incubation Temperature	37°C ±2°C
Incubation time	18-24 hrs
Number of washing	-
Washing method	-

Test on a sample of a pink woven fabric treated with the compound of Example 3

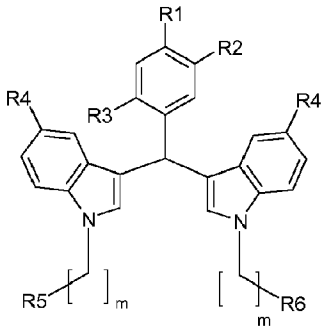
Inhibition Zone mm (1)	Bacteria Growth(2)
0	(-)
(-) no bacterial colonies directly under the treated sample in the contact area were observed. Inhibition zone exists - Good Effect (5) Width of clear zone of inhibition in mm (6) (-) no bacterial colonies directly under the treated sample	

Microorganism	*Staphylococcus aureus* ATCC 6538 Gram (+)
Size of sample	*25x50 mm*
Incubation Temperature	37°C ±2°C
Incubation time	18-24 hrs
Number of washing	-
Washing method	-

HIDTIL UKENDTE BIS-INDOLYLMETHANER, FREMGANGSMÅDE TIL FREMSTILLING HERAF OG ANVENDELSER DERAF

PATENTKRAV

1. Forbindelse med formlen (I)



(I)

hvor

- R_1 er udvalgt fra hydrogen, et halogenatom, en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkylguppe og en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkoxygruppe; når R_2 og R_3 er H;
- R_2 er udvalgt fra hydrogen, en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkylguppe og en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkoxygruppe; når R_1 er H og R_3 er alkyl eller alkoxygrupper som defineret ovenfor;
- R_3 er udvalgt fra hydrogen, et halogenatom, en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkylguppe og en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkoxygruppe; når R_1 er H og R_3 er halogen, alkyl eller alkoxy som defineret ovenfor;
- R_4 er udvalgt fra en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkylguppe og en ikke-substitueret, mættet eller umættet, lineær eller forgrenet, acyklisk C1-C10-alkoxygruppe;
- R_5 er udvalgt fra et halogenatom; polyvinylalkohol; polyvinylamin og en cellulosepolymer;
- R_6 er udvalgt fra et halogenatom; polyvinylalkohol; polyvinylamin og en cellulosepolymer;
- m er fra 3 til 5.

2. Forbindelse ifølge krav 1, kendetegnet ved, at R_2 er hydrogen; R_1 og R_3 begge er chlor; R_4 og R_5 begge er methylgrupper; R_5 og R_6 begge er brom og m er 4.

3. Forbindelse ifølge krav 1, kendetegnet ved, at R_1 er hydrogen; R_2 og R_3 begge er en methoxygruppe; R_4 er en methylgruppe; R_5 og R_6 begge er brom og m er 4.

4. Forbindelse ifølge krav 1, kendetegnet ved, at R_1 er fluor; R_2 og R_3 begge er hydrogen; R_4 er en methylgruppe; R_5 og R_6 begge er brom og m er 4.

5. Forbindelse ifølge krav 1, kendetegnet ved, at R_2 er hydrogen; R_1 og R_1 begge er chlor; R_4 er methylgrupper; R_5 er brom og R_6 er polyvinylalkohol og m er 4.

6. Forbindelse ifølge krav 1, kendetegnet ved, at R_1 er hydrogen; R_2 og R_3 begge er en methoxygruppe; R_4 er en methylgruppe; R_5 er brom og R_6 er polyvinylalcol og m er 4.

7. Forbindelse ifølge krav 1, kendetegnet ved, at R_1 er fluor; R_2 og R_3 begge er hydrogen; R_4 er en methylgruppe; R_5 er brom og R_6 er polyvinylalcol og m er 4.

8. Forbindelse ifølge et hvilket som helst af kravene 1, 5, 6 og 7, kendetegnet ved, at PVA-molekylvægt er omtrent 100.000-130.000 g/mol med en Pw: 2.700 (polymeriseringsgrad) og hydrolyseforhold: 86-88 %.

9. Anvendelse af mindst én forbindelse ifølge et hvilket som helst af kravene 1 til 8 inden for tekstilområdet og i fremstillingen af solbeskyttende og antiinfektionsstoffer.

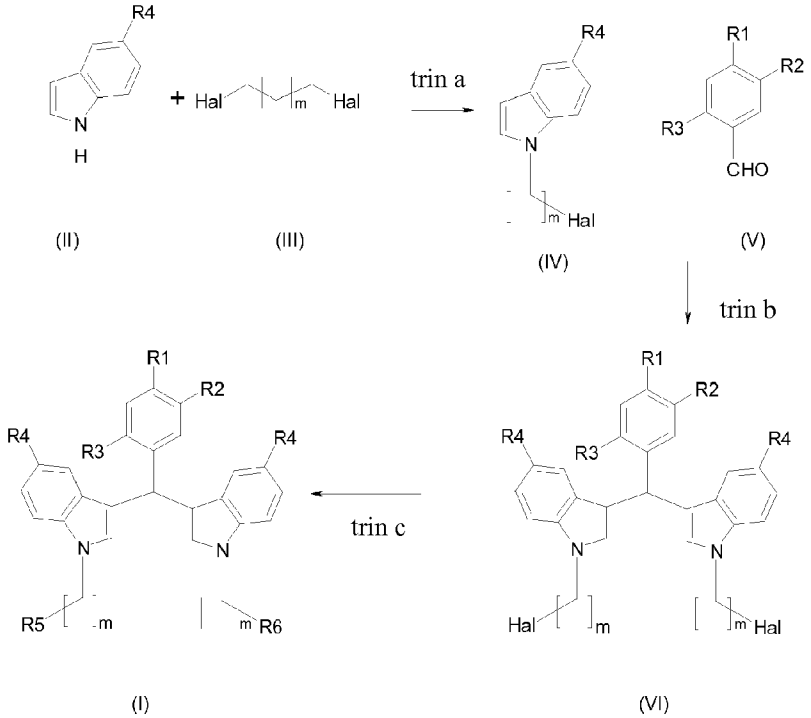
10. Anvendelse ifølge krav 9, kendetegnet ved, at stofferne er bomuldsstoffer.

11. Anvendelse ifølge krav 9, kendetegnet ved, at stofferne er denim.

12. Fremgangsmåde til at fremstille solbeskyttende og antiinfektionsstoffer, hvilken fremgangsmåde omfatter behandling af stofferne med mindst én forbindelse ifølge et hvilket som helst af kravene 1 til 8.

13. Stoffer, tøj og personligt sikkerhedsudstyr, der er behandlet med mindst én forbindelse ifølge et hvilket som helst af kravene 1 til 8.

14. Fremgangsmåde til fremstilling af en forbindelse ifølge et hvilket som helst af kravene 1 til 8, der omfatter omsætning af forbindelser med formlen (II) og (III) ifølge nedenstående skema



15. Fremgangsmåde ifølge krav 14, kendetegnet ved, at, i trin (a), en forbindelse med formlen (II) omsættes med en forbindelse med formlen (III) i et egnet opløsningsmiddel i tilstedeværelse af en kraftig base, hvor molforholdet mellem forbindelse (II)/forbindelse (III)/base er omtrent 1/4/2.

16. Fremgangsmåde ifølge krav 14 eller 15, kendetegnet ved, at, i trin (b) en forbindelse med formlen (IV) omsættes med benzaldehyd med formlen (V) i et molforhold på mindst 2/1 i tilstedeværelse af

katalytiske mængder af 1,3-dibrom-5,5-dimethylhidantoin (DBDMH) uden tilstedeværelse af noget som helst opløsningsmiddel.

17. Fremgangsmåde ifølge et hvilket som helst af kravene 14 til 16, kendetegnet ved, at, i trin (c), en forbindelse (VI) omsættes med en reaktant, der er udvalgt fra polyvinylalkohol; polyvinylamin og en cellulosepolymer, i et egnet opløsningsmiddel og i tilstedeværelse af en base.

18. Fremgangsmåde ifølge et hvilket som helst af kravene 14 til 17, kendetegnet ved, at Hal er brom og R_4 er methyl.

19. Fremgangsmåde ifølge et hvilket som helst af kravene 14 til 18, kendetegnet ved, at R_5 er brom og R_6 er PVA.

DRAWINGS

Figure 1

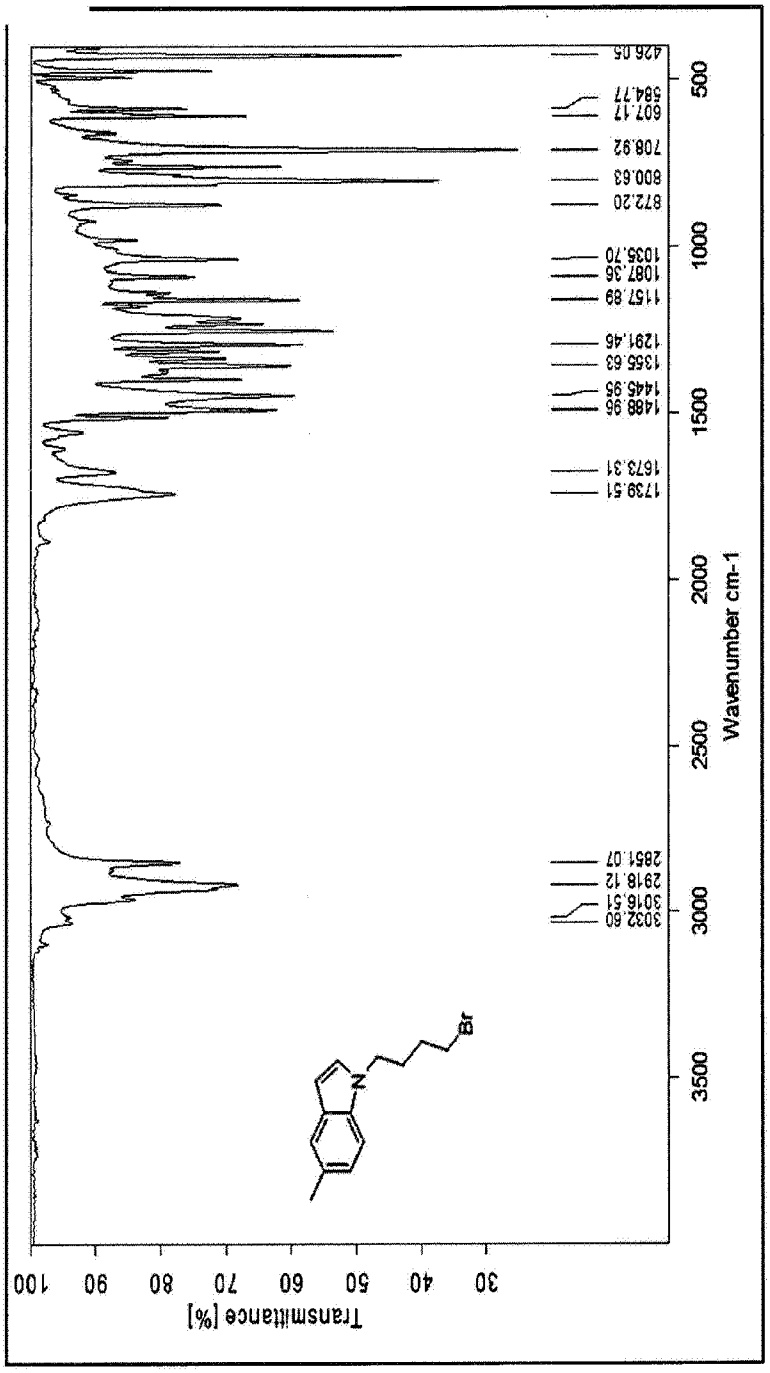
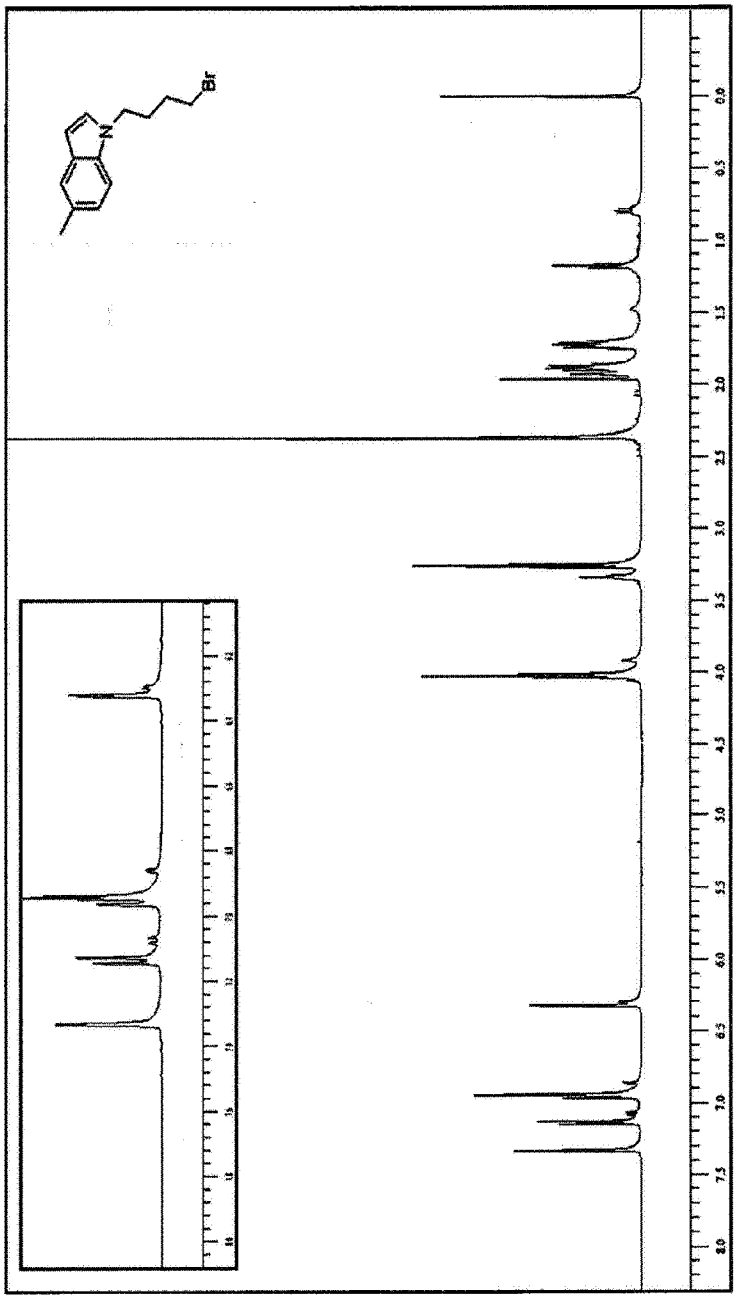
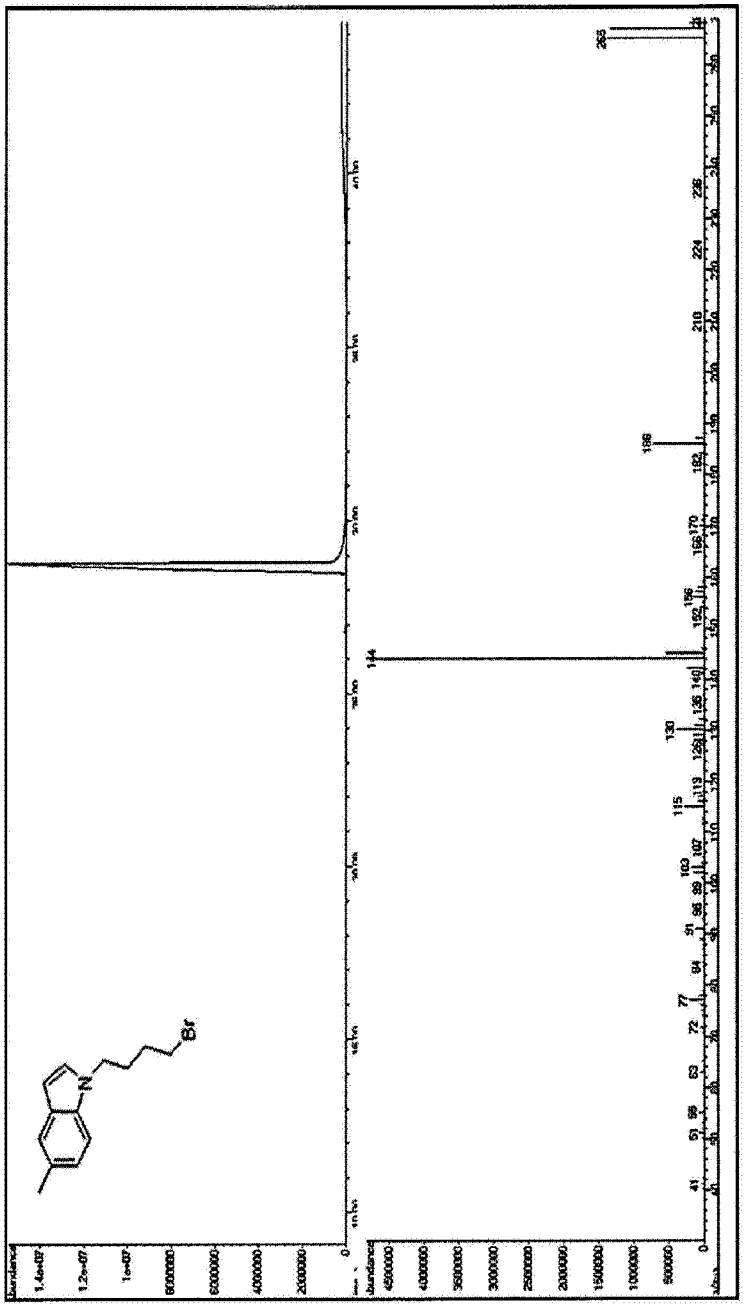


Figure 2



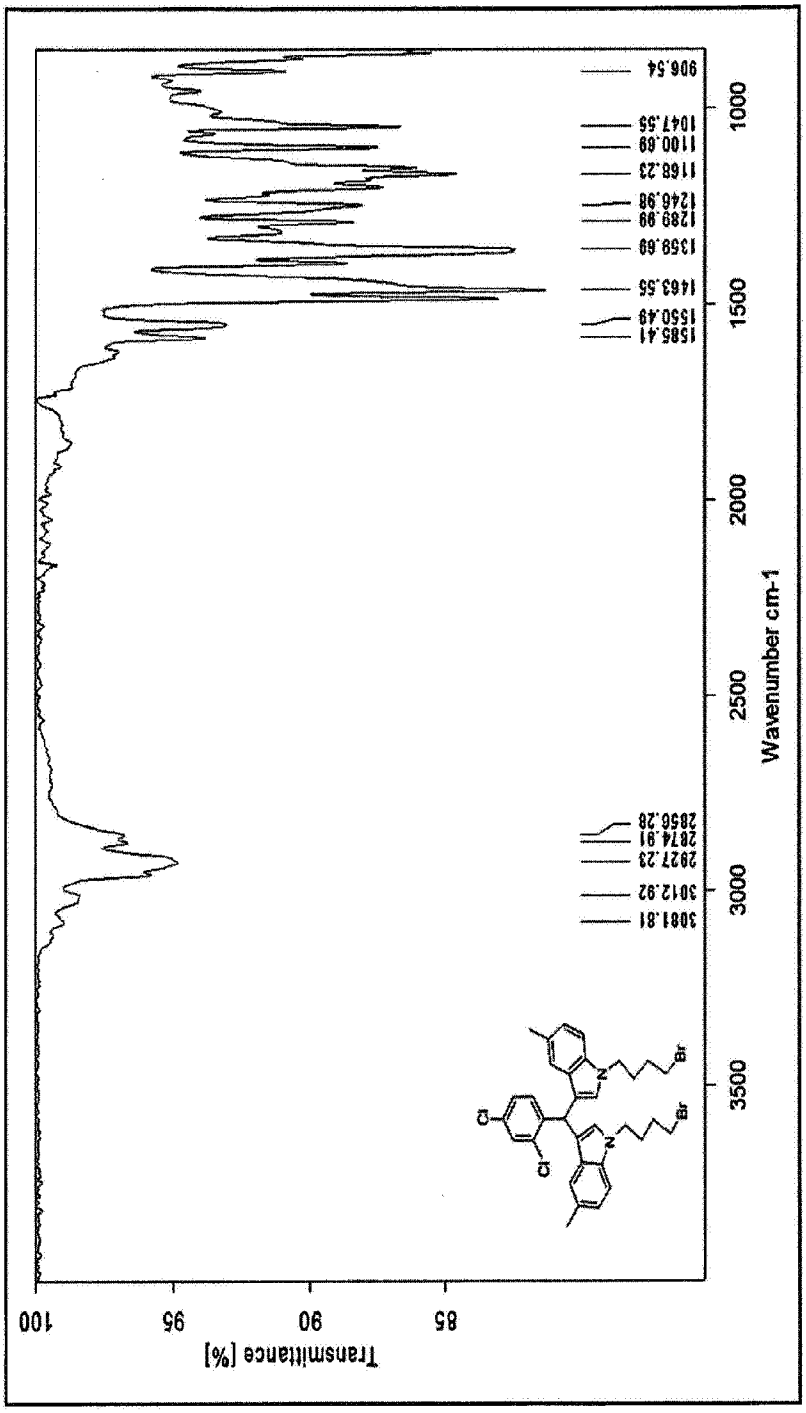
^{1}H NMR Spectrum

Figure 3



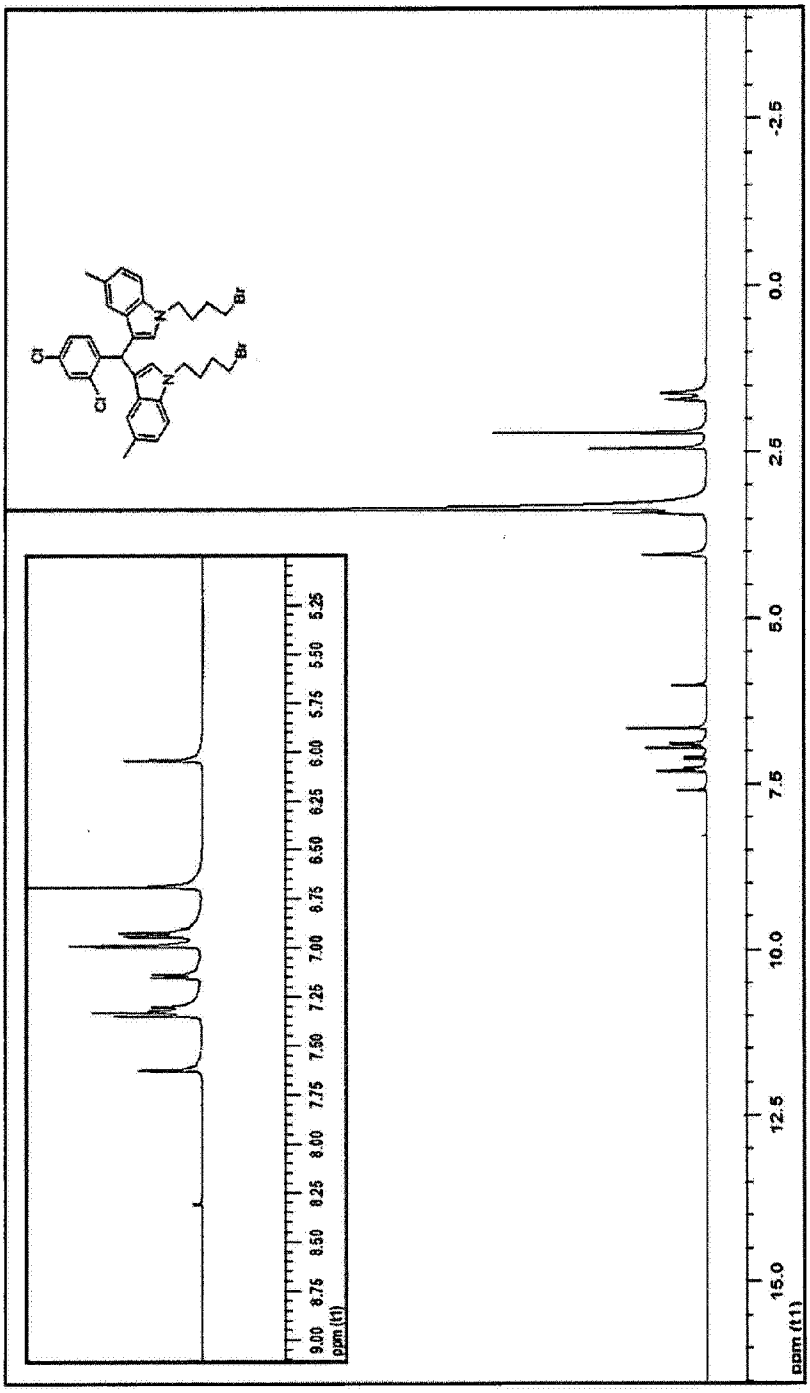
GC-MS Spectrum

Figure 4



FTIR (ATR) Spectrum

Figure 5



^{1}H NMR Spectrum

Figure 6

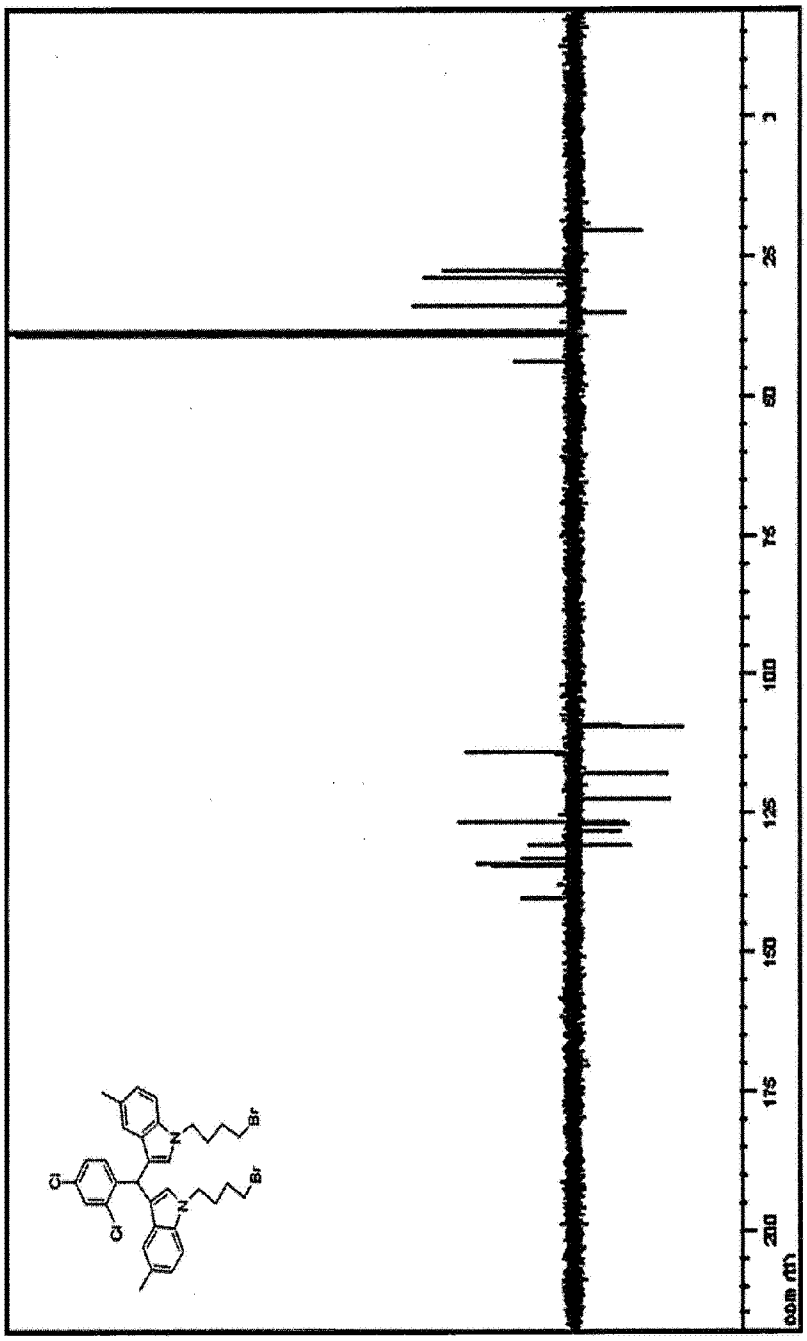
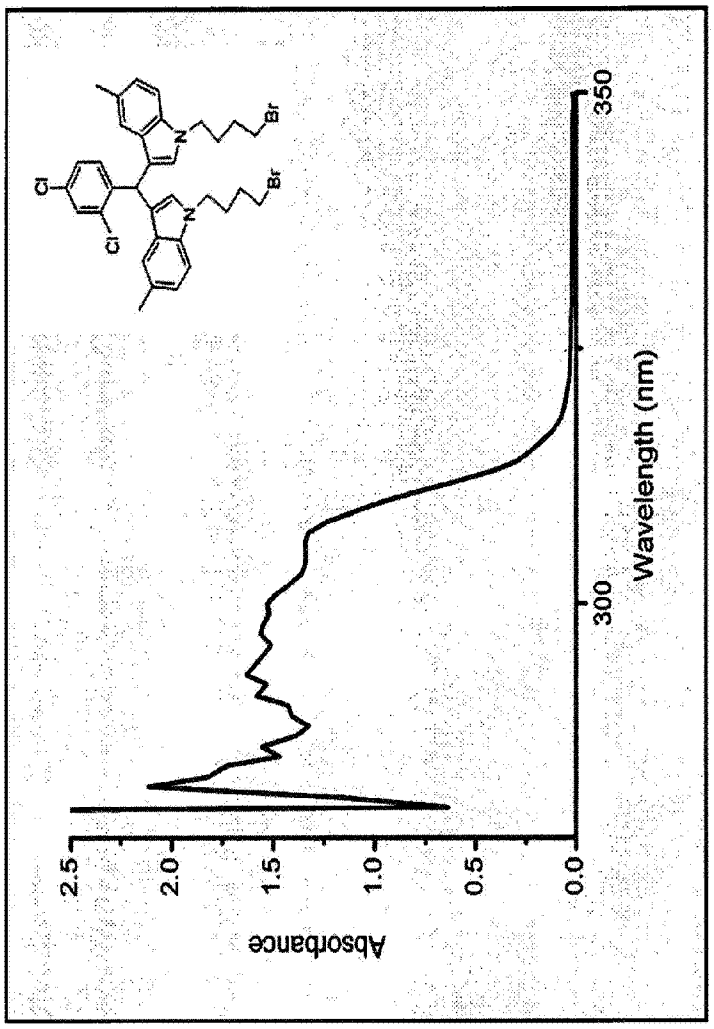


Figure 7



UV Spectrum

Figure 8

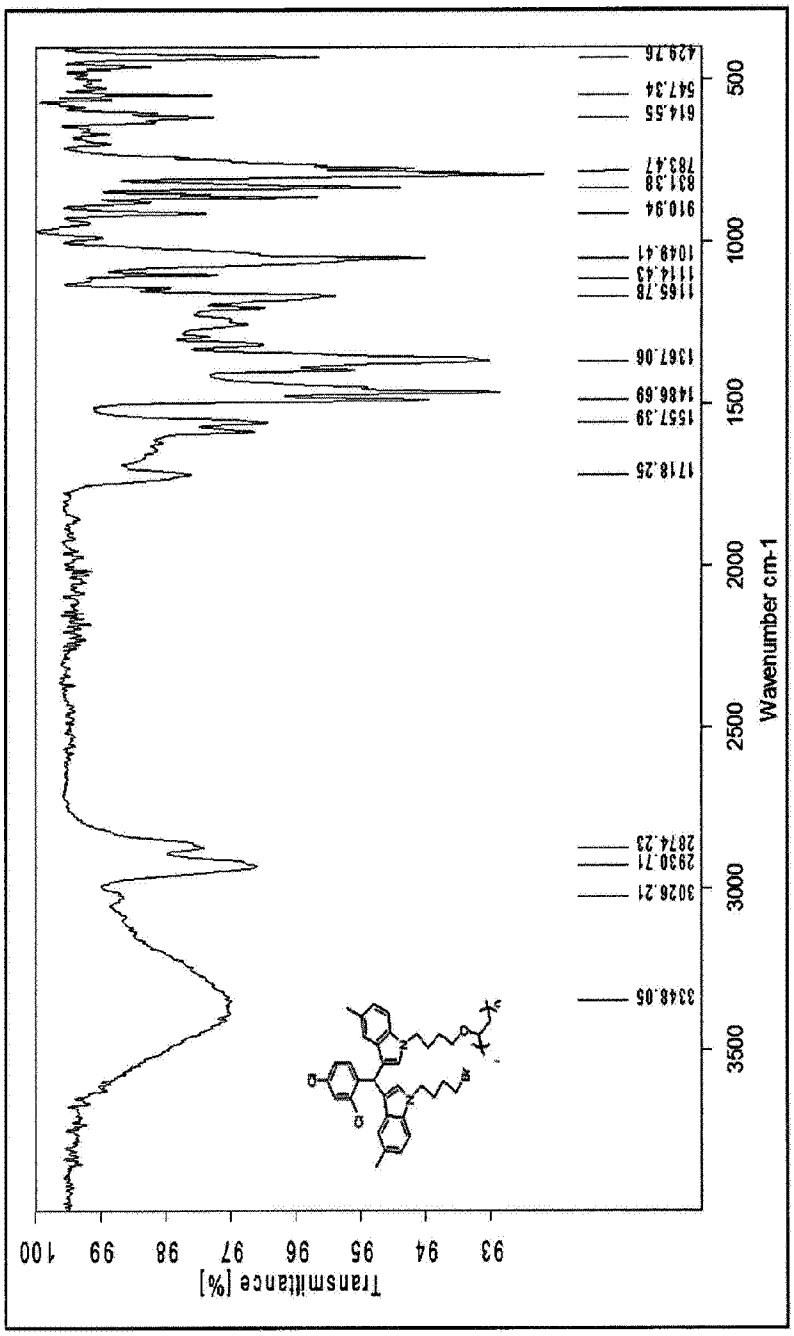
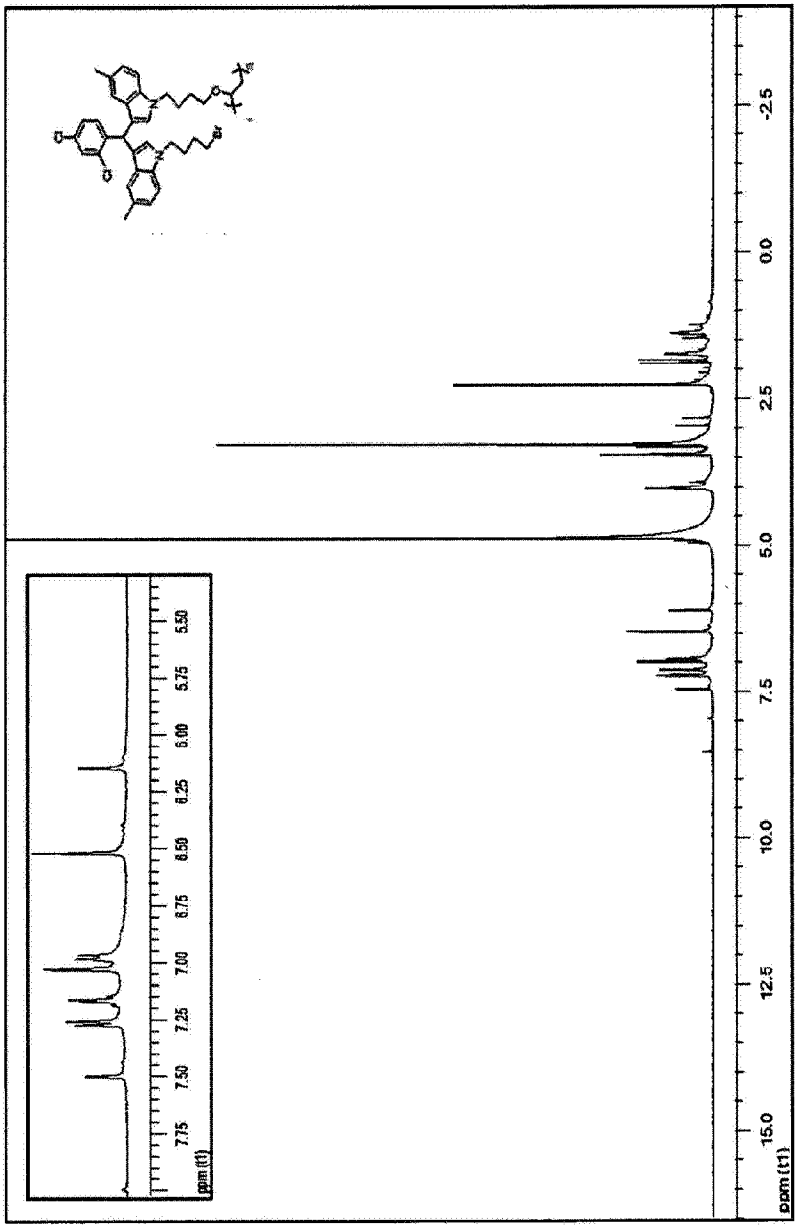
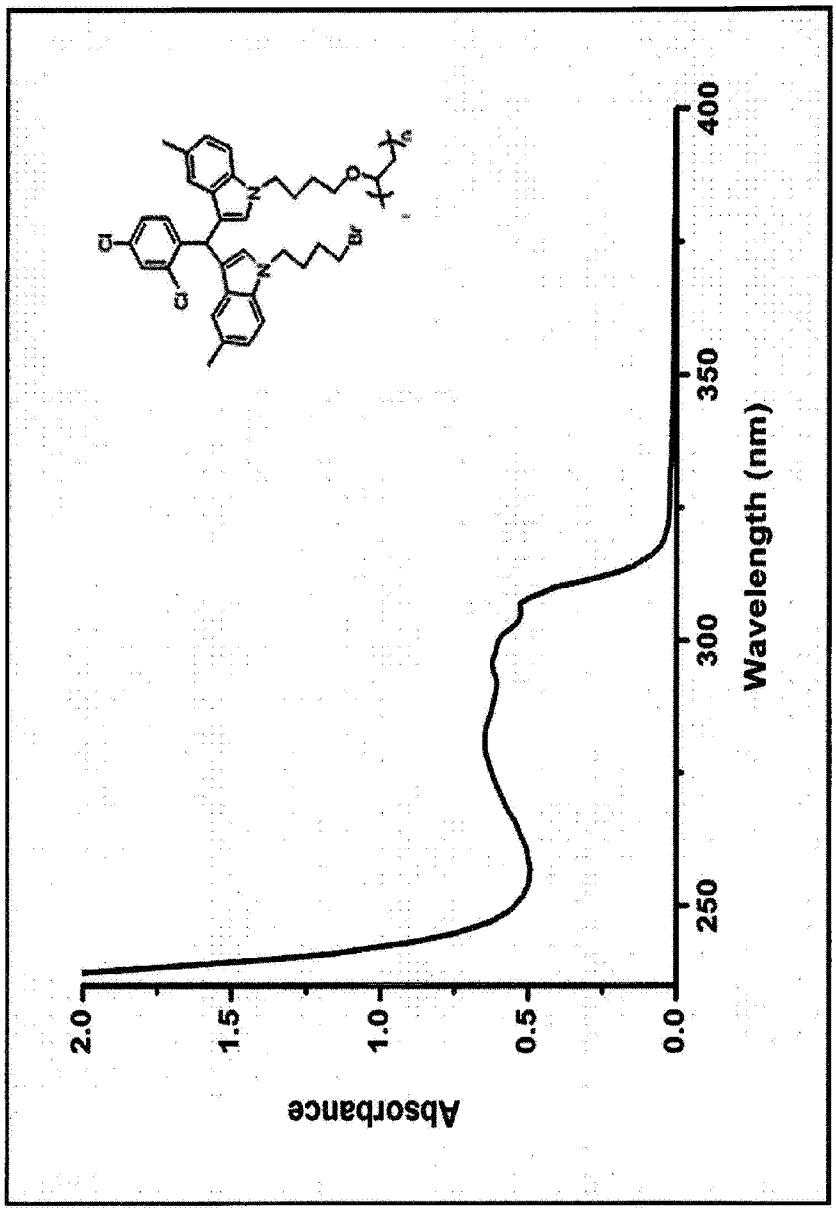

FTIR (ATR) Spectrum
Transmittance [%]
100
99
98
97
96
95
94
93
Wavenumber cm-1
3500
3000
2500
2000
1500
1000
500
3348.05
3026.21
2930.71
2874.23
1718.25
1557.39
1486.69
1367.06
1165.78
1114.43
1048.41
910.94
831.38
783.47
614.55
547.34
429.76

Figure 9



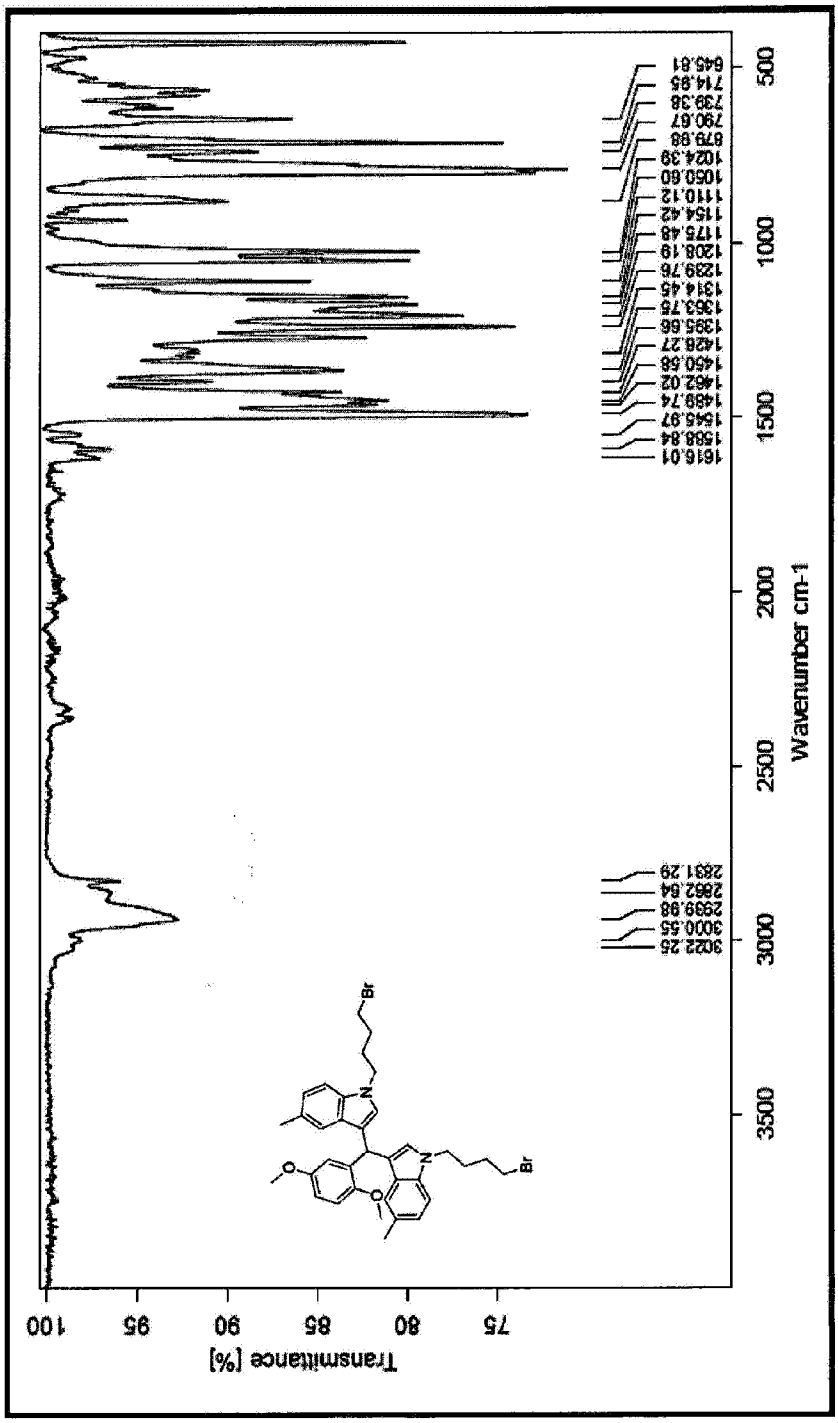
^{1}H NMR Spectrum

Figure 10



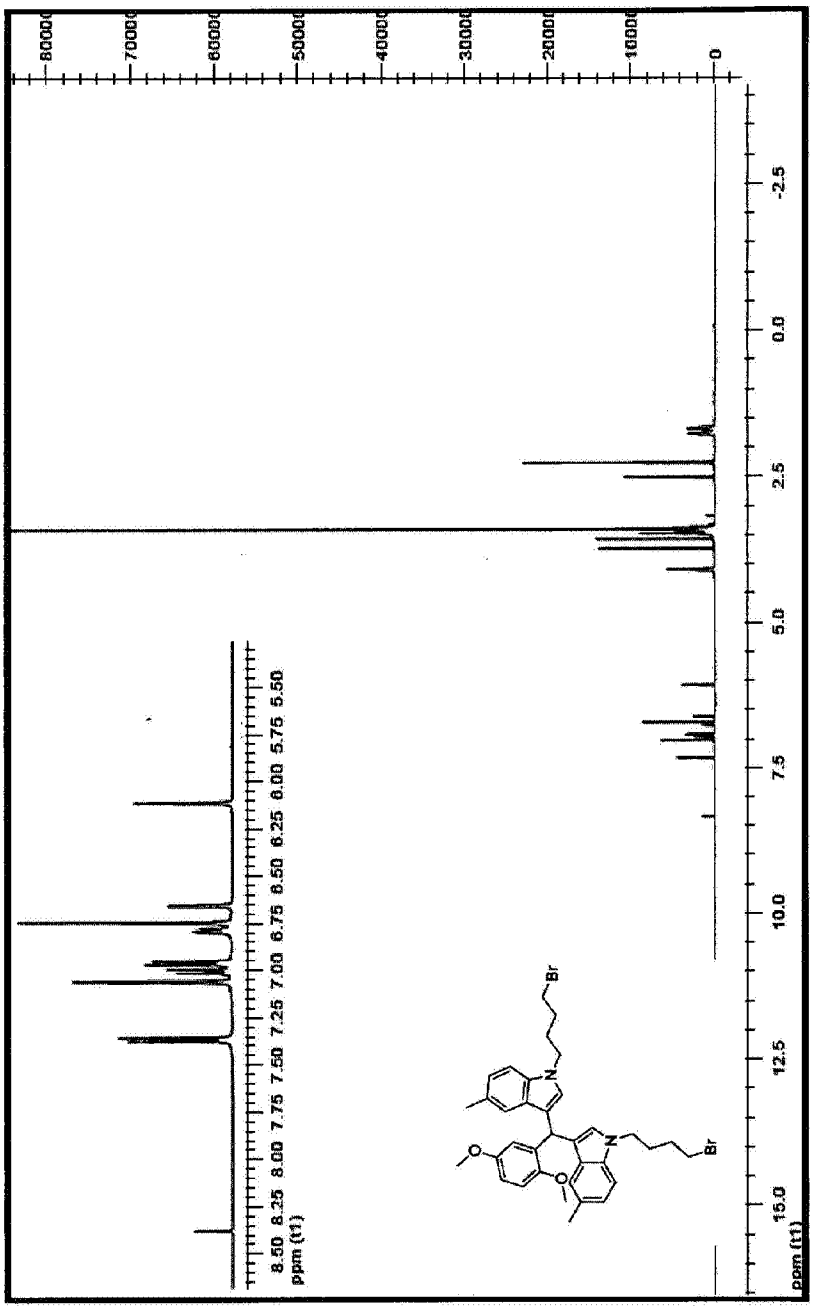
UV Spectrum

Figure 11



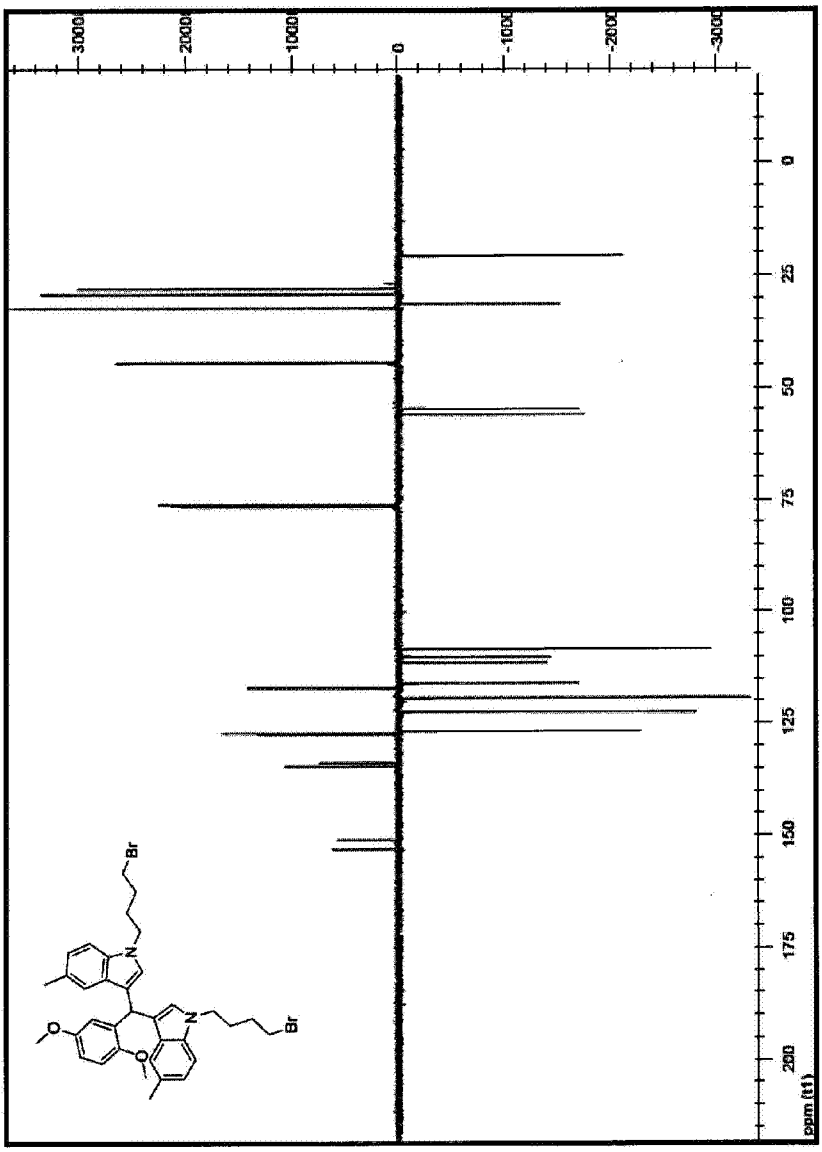
FTIR (ATR) Spectrum

Figure 12



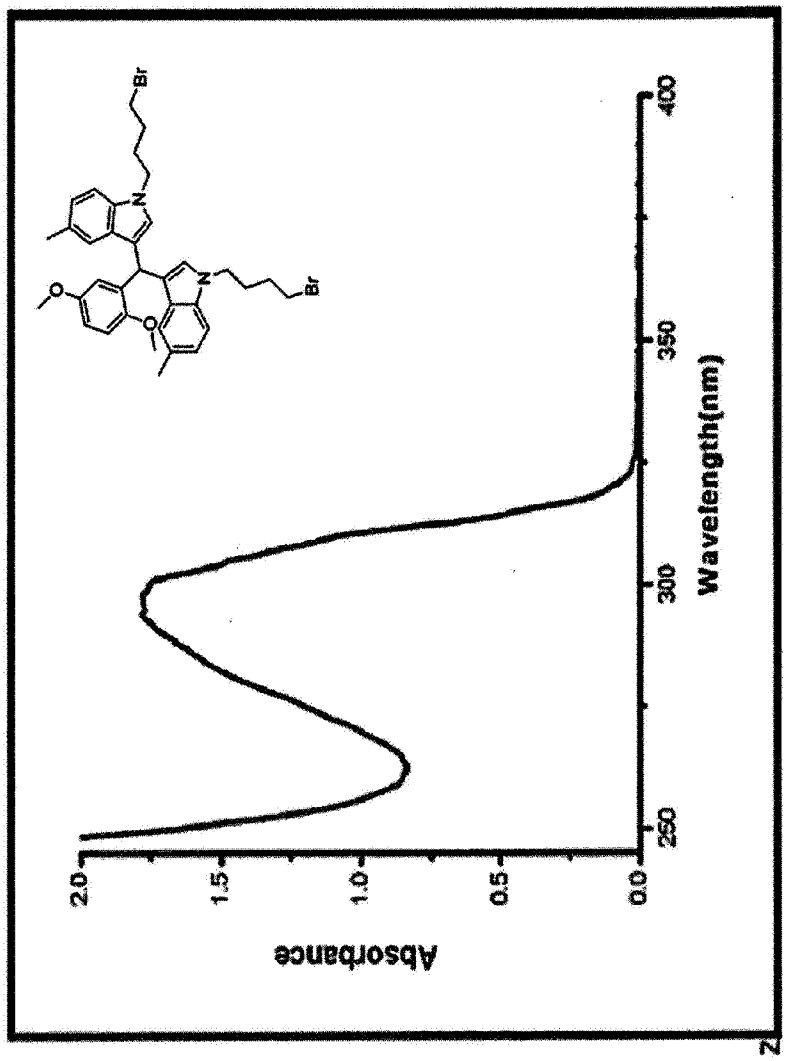
1H NMR spectrum

Figure 13



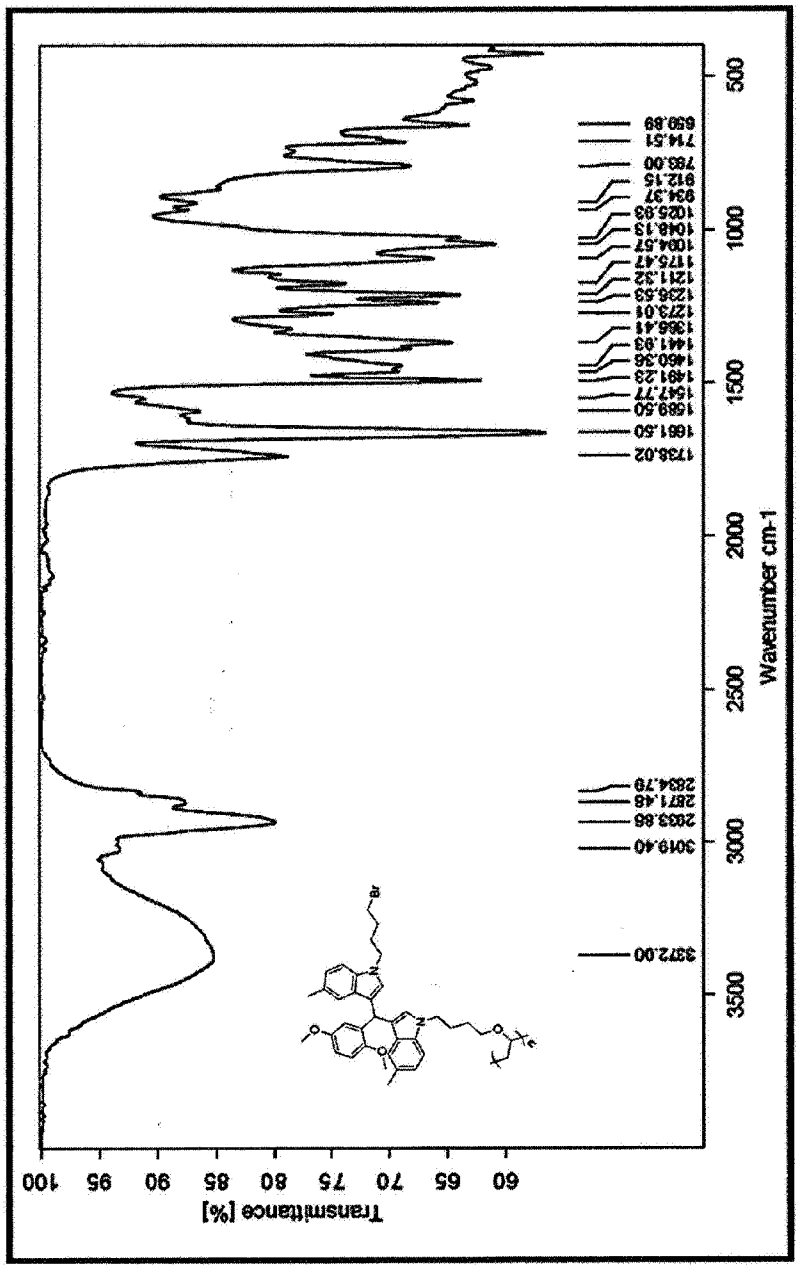
^{13}C NMR Spectrum(APT)

Figure 14



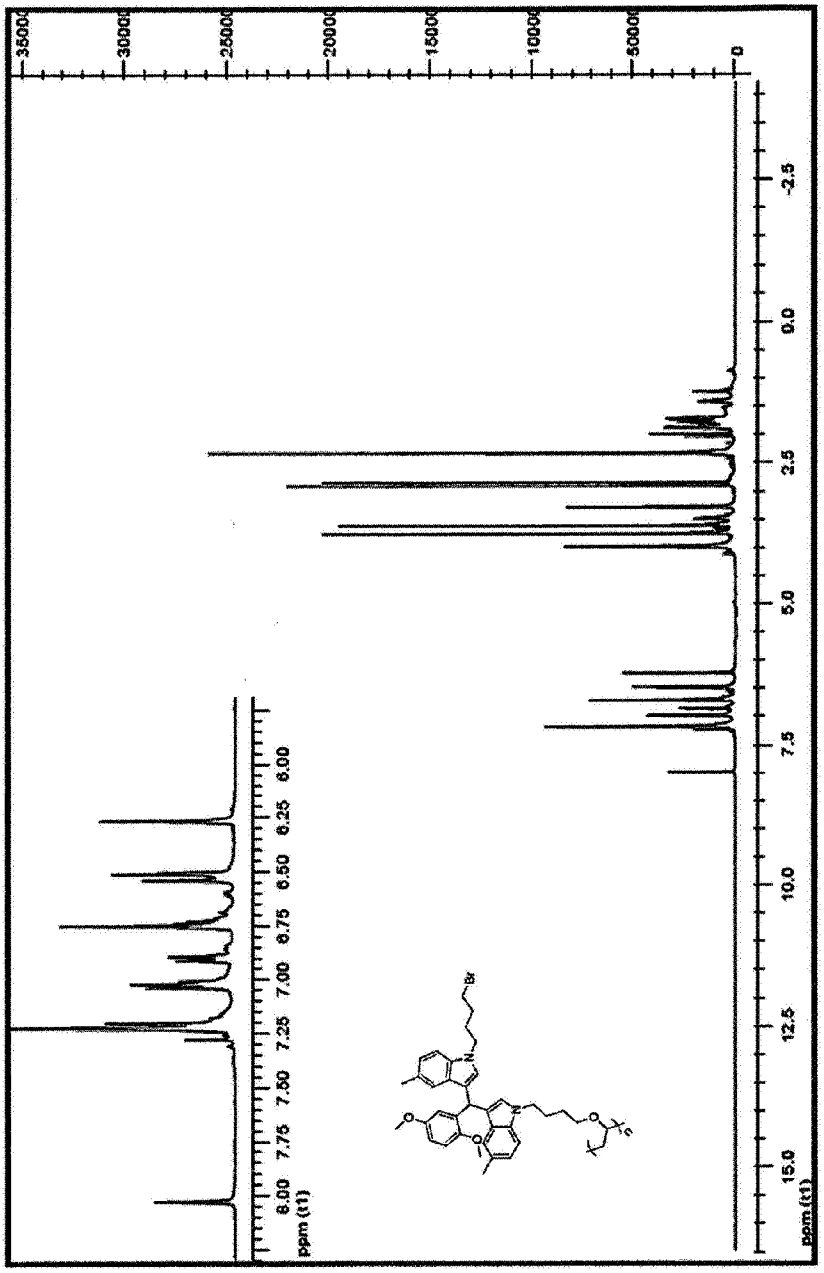
UV Spectrum

Figure 15



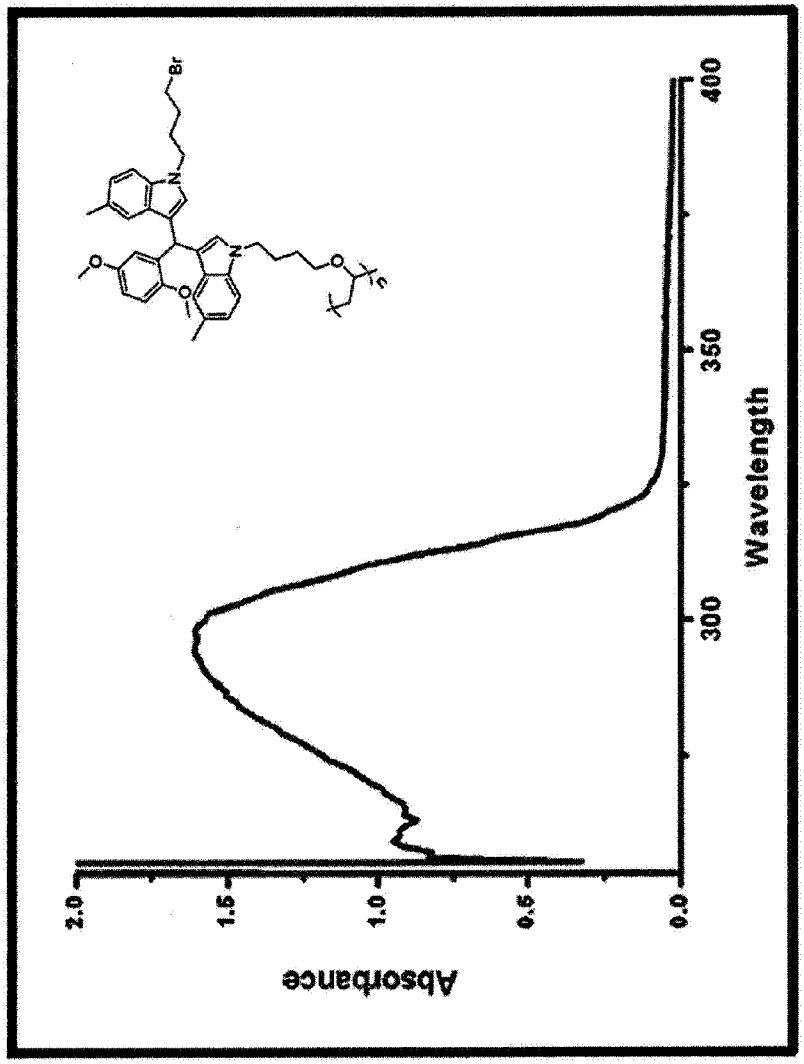
FTIR (ATR) Spectrum

Figure 16



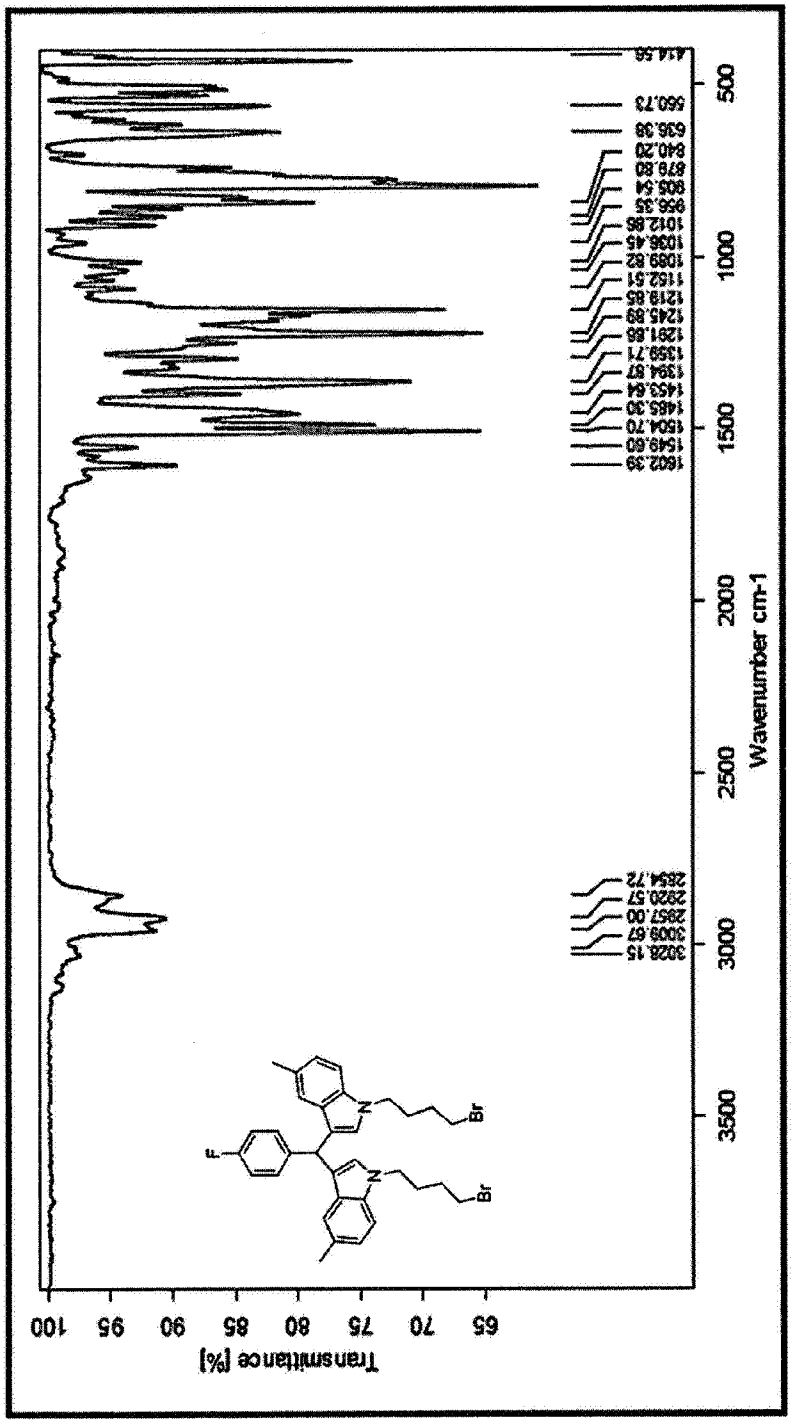
1H NMR Spectrum

Figure 17



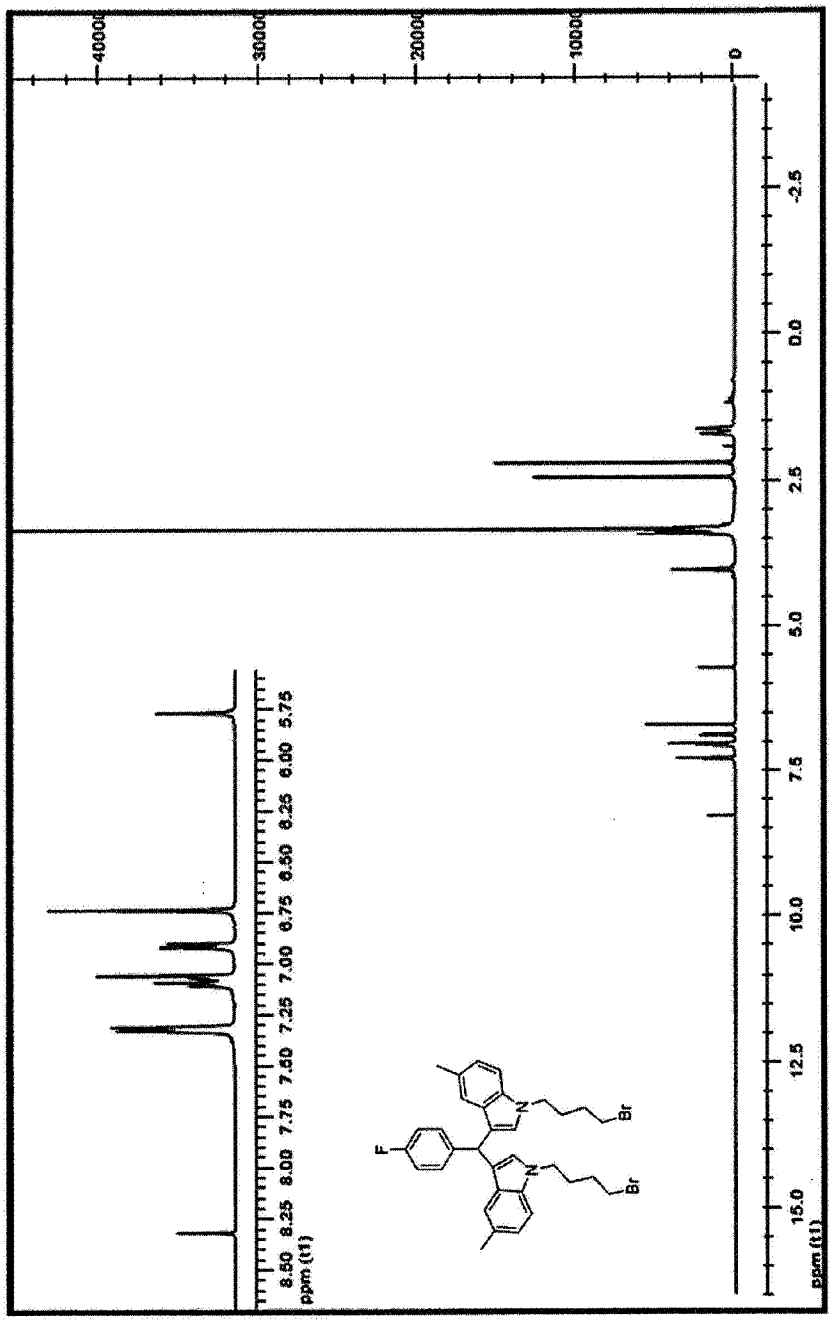
UV Spectrum

Figure 18



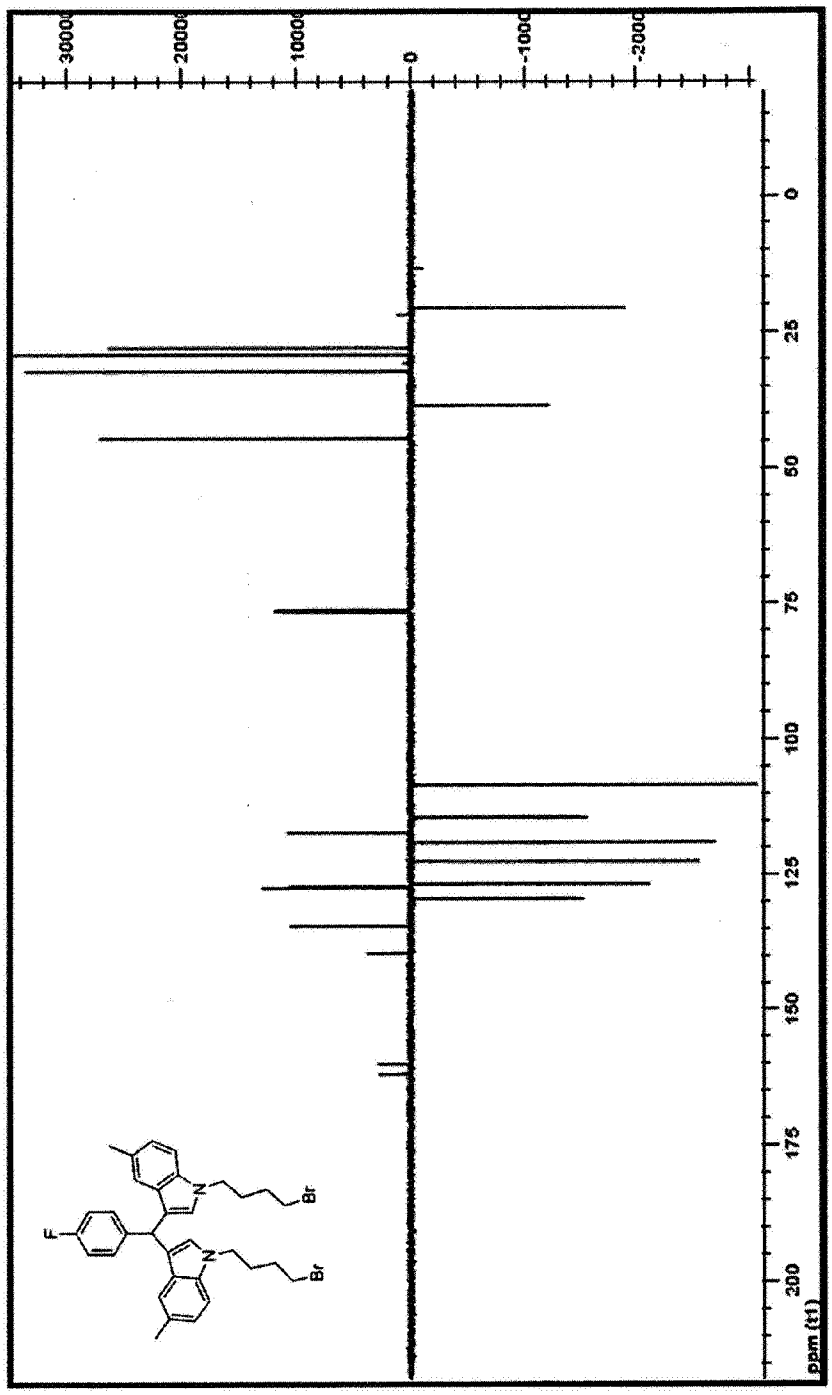
FTIR (ATR) Spectrum

Figure 19



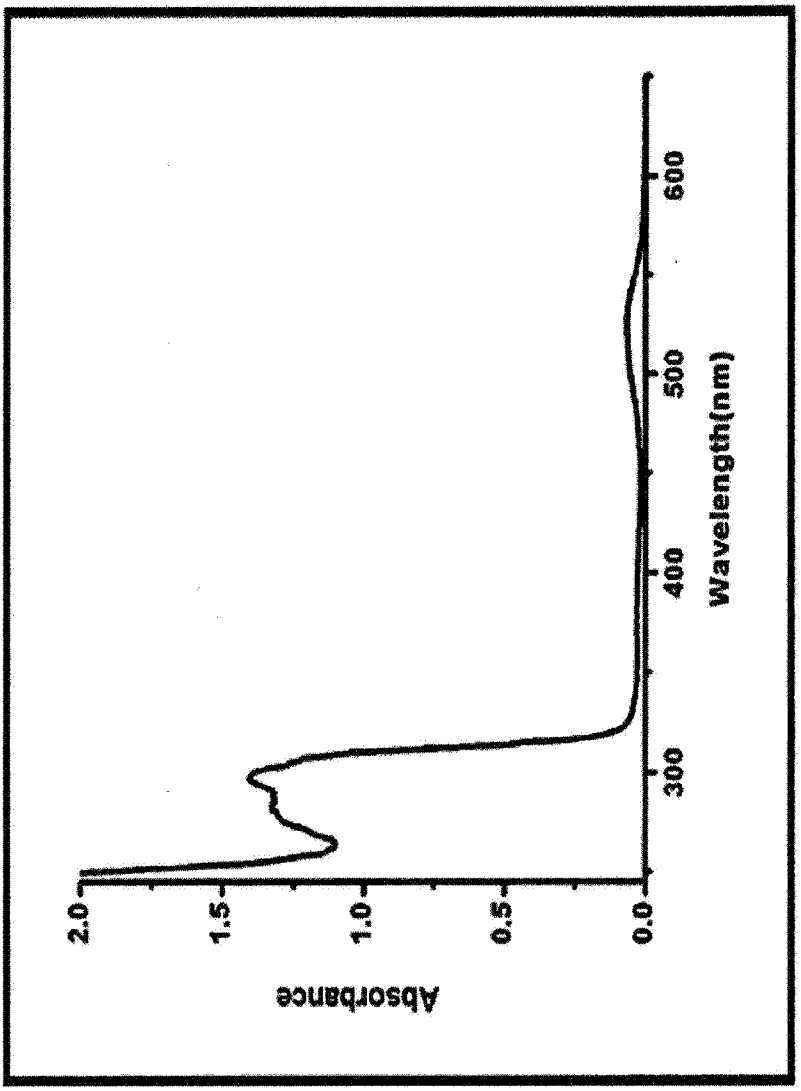
1H NMR Spectrum

Figure 20



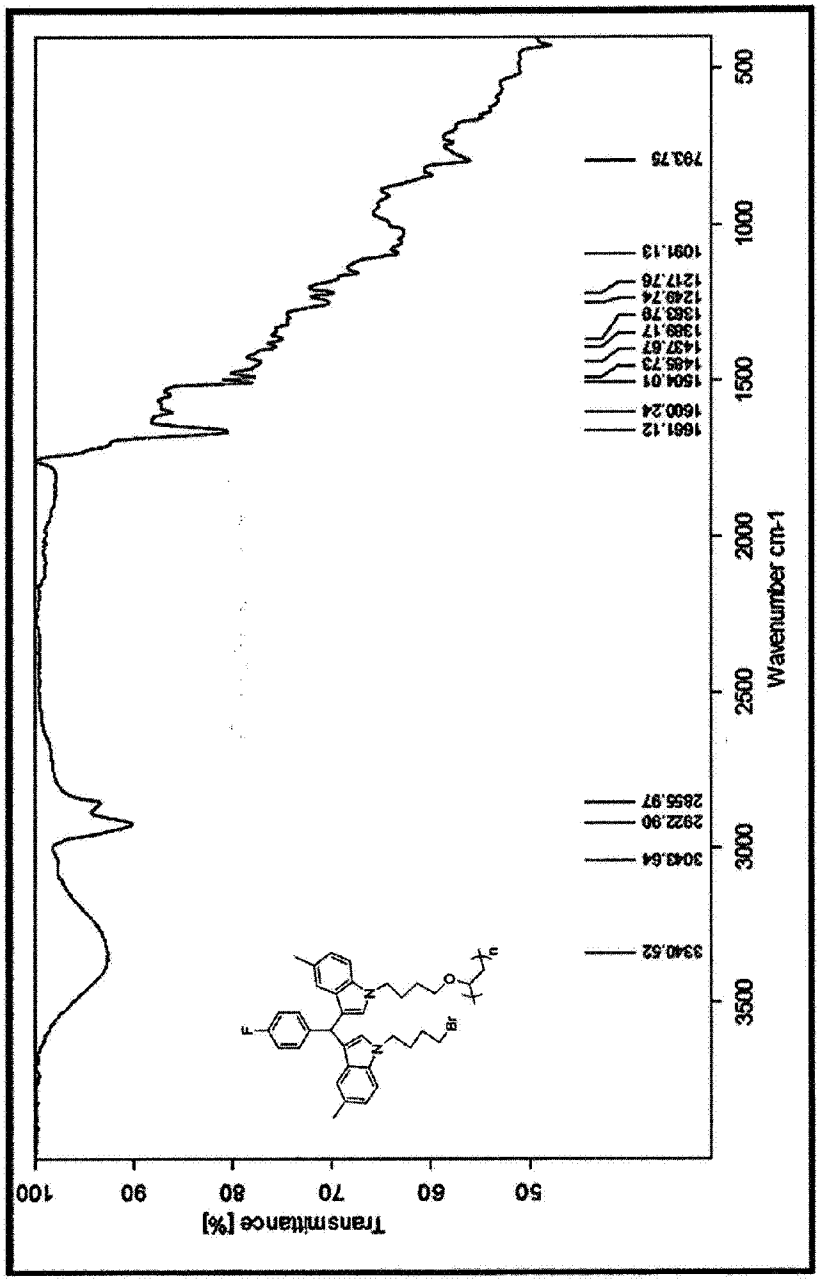
13C NMR Spectrum

Figure 21



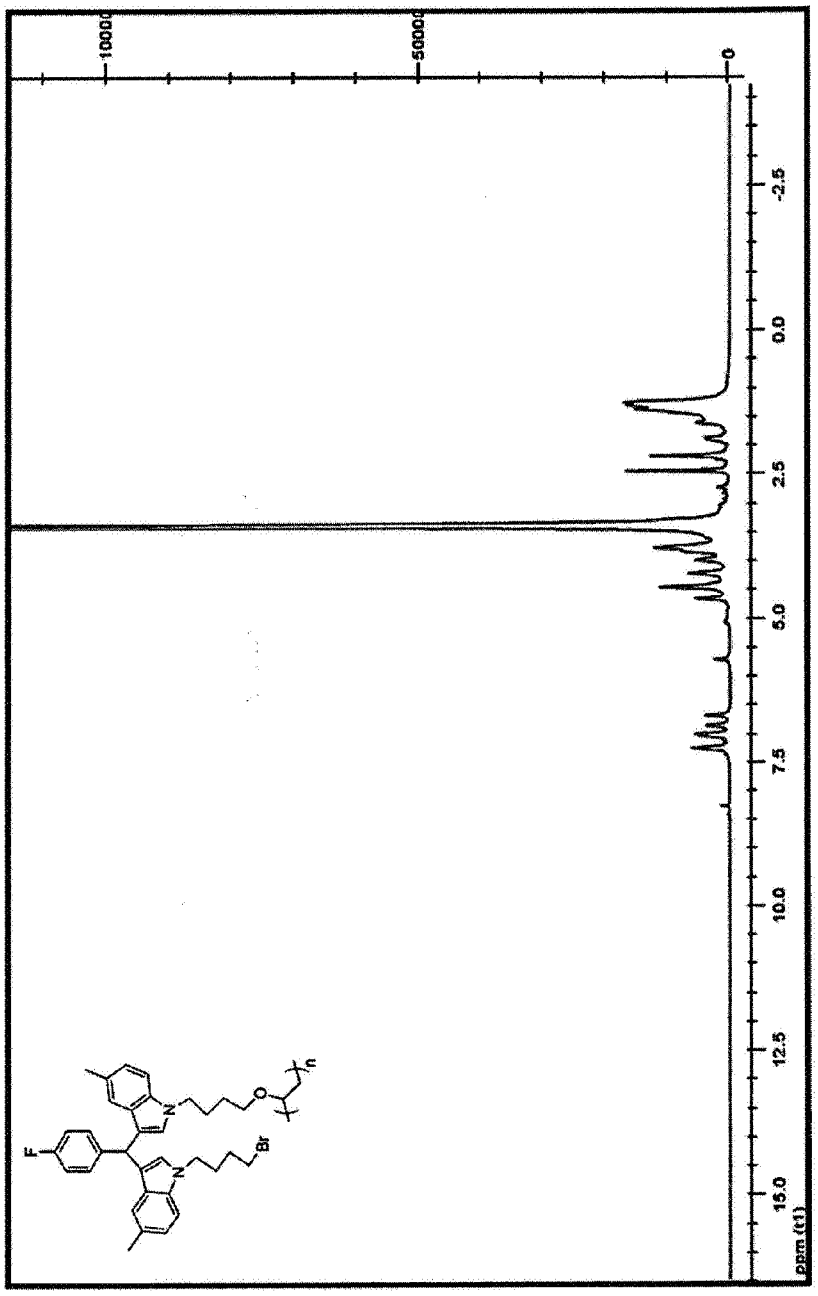
UV Spectrum

Figure 22



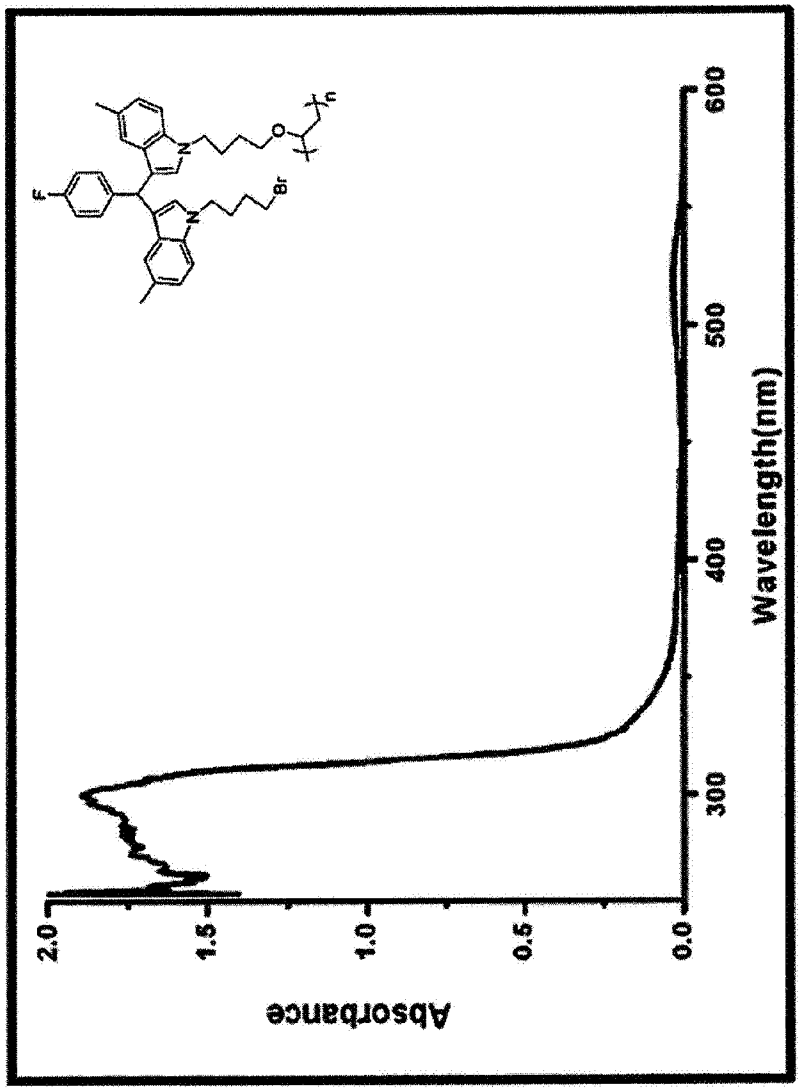
FTIR (ATR) Spectrum

Figure 23



1H NMR Spectrum

Figure 24



UV Spectrum

Figure 25

Number of Specimen	UVA TRANSMITTANCE (315-400 nm) (%)	UVB TRANSMITTANCE (280-315 nm)	ULTRAVIOLET PROTECTION FACTOR (UPF)	UVA BLOCKING (%)	UVB BLOCKING (%)
1	6.1	2.3	28.6	93.9	97.7
2	5.2	1.6	39.7	94.8	98.4
3	4.9	1.8	36.4	95.1	98.2
4	6.7	2.5	27.3	93.3	97.5
5	4.8	1.8	38.2	95.2	98.2
6	6.2	2.1	30.0	93.8	97.9
AVERAGE	5.65	2.02	33.37	94.35	97.98
STANDARD DEVIATION	0.79	0.34	5.36	0.79	0.34

ULTRAVIOLET PROTECTION VALUE for LABEL (According to ASTM D 6603- Unprepared Specimen): 27

Protection Classification

Good UV-protection category: between 15 and 24 UPF Value

Very Good UV-protection category: between 25 and 39 UPF Value

Excellent UV-protection category to UPF Value 40 or greater

DK/EP 3153505 T3

Figure 26

DRY

Number of Specimen	UVA TRANSMITTANCE (315-400 nm)	UVB TRANSMITTANCE (280- 315 nm)	ULTRAVIOLET PROTECTION FACTOR (UPF)	UVA blocking (%)	UVB blocking (%)
1	0.2	0.1	516.0	99.8	99.9
2	0.2	0.1	1929.3	99.8	99.9
3	0.2	0.1	1379.4	99.8	99.9
4	0.6	0.1	735.6	99.6	99.9
5	0.3	0.1	1868.5	99.7	99.9
6	0.3	0.1	1371.9	99.7	99.9
AVERAGE:	0.30	0.10	1300.12	99.7	99.9
STANDARD DEVIATION:	0.15	0.00	576.87	0.15	0.00
*ULTRAVIOLET PROTECTION FACTOR FOR LABEL		+40			

Protection Classification

Good UV-protection category: between 15 and 24 UPF Value

Very Good UV-protection category: between 25 and 39 UPF Value

Excellent UV-protection category to UPF Value 40 or greater

Figure 27

DRY

Number of Specimen	UVA TRANSMITTANCE (315-400 nm)	UVB TRANSMITTANCE (280- 315 nm)	ULTRAVIOLET PROTECTION FACTOR (UPF)	UVA blocking (%)	UVB blocking (%)
1	2.0	0.2	250.6	98.0	99.8
2	2.2	0.2	223.4	97.8	99.8
3	2.3	0.2	171.1	97.7	99.8
4	2.2	0.2	230.1	97.8	99.8
5	2.1	0.2	255.1	97.9	99.8
6	2.1	0.3	170.3	97.9	99.7
AVERAGE:	2.15	0.22	216.77	97.85	99.78
STANDARD DEVIATION:	0.10	0.04	37.63	0.10	0.04
*ULTRAVIOLET PROTECTION FACTOR FOR LABEL		+40			

Protection Classification

Good UV-protection category: between 15 and 24 UPF Value

Very Good UV-protection category: between 25 and 39 UPF Value

Excellent UV-protection category to UPF Value 40 or greater

Figure 28

DRY

Number of Specimen	UVA TRANSMITTANCE (315-400 nm)	UVB TRANSMITTANCE (280-315 nm)	ULTRAVIOLET PROTECTION FACTOR (UPF)	UVA blocking (%)	UVB blocking (%)
1	3.2	0.3	166.7	96.8	99.7
2	3.0	0.4	157.2	97.0	99.6
3	3.1	0.4	153.2	96.9	99.6
4	2.9	0.4	140.2	97.1	99.6
5	3.5	0.4	128.6	96.5	99.6
6	3.6	0.4	130.8	96.4	99.6
AVERAGE:	3.22	0.38	146.12	96.79	99.62
STANDARD DEVIATION:	0.28	0.04	15.32	0.29	0.04
*ULTRAVIOLET PROTECTION FACTOR FOR LABEL		+40			

Protection Classification

Good UV-protection category: between 15 and 24 UPF Value

Very Good UV-protection category: between 25 and 39 UPF Value

Excellent UV-protection category to UPF Value 40 or greater

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