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(71) Applicant (for all designated States except US): BASF SE [DE/DE]; 67056 Ludwigshafen (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): TANABE, Junichi [JP/JP]; 1-40-8-401, Muko-cho, Amagasaki-shi, Hyogo 661-0044 (JP). TAKESUE, Mamiko [JP/JP]; 2-11-704, Itoyamachi 1-chome, Chuo-ku, Osaka 540-0022 (JP).

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(54) Title: PIGMENT DISPERSANTS WITH MODIFIED COPOLYMERS

(57) Abstract: The present invention pertains to salt modified copolymers wherein one of the monomer units contains a quaternized N-atom structure with a polar substituent. The invention further relates to the use of said copolymers as dispersant especially for color filters. The copolymer is made by controlled polymerisation or by conventional polymerization and comprises at least one monomer (MA_r) selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers, at least one monomer (MB_s) selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers wherein the monomer MB has a quaternized N-atom structure with a polar substituent selected from polyether, polyamine, nitrile, amide, imine, imide, ester, ketone, nitrile, aldehyde, diketone, ketoester, ketoamide, carbonate, carbamate, carbamide, sulfoxide, sulfone, carboxylic acid, sulfonic acid, phosphoric acid groups; or carboxylic acid anion, sulfonic acid anion or phosphoric acid anion groups which is formed as betaine structure r denotes the total number of monomers MA within the structural element (MA_r) and r is > 5, preferred 10-1000, most preferred 10-500; s denotes the total number of monomers MB within the structural element (MB_s) and s is > 1, preferred 2-100, most preferred 2-50.



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Pigment dispersants with modified copolymers

The present invention pertains to salt modified copolymers wherein one of the monomer units contains a quaternized N-atom structure with a polar substituent. The invention further relates to the use of said copolymers as dispersant especially for color filters.

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In color filter application particle size of pigment is getting smaller and smaller to have better color property, and also photolithographic process becomes very important for higher throughput and CF production stability. However such a small pigment makes dispersing more difficult and photolithographic process, especially resist development property is still not optimum.

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Therefore there is a strong need for dispersant to improve dispersibility and development property.

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The European Patent publication EP1275689 (Ciba) describes block copolymers of the formula X-Ax-By-Y wherein X and Y represent chain terminal groups from fragments of a polymerisation initiator and A and B represent different polymer blocks composed of non-ionic repeating units of ethylenically unsaturated monomers, additionally contains repeating units of ethylenically unsaturated monomers substituted with ionic groups. Disclosed are for example polymers of n-butyl acrylate and 2-dimethylaminoethyl acrylate (DMAEA) or n-butyl acrylate and 4-vinylpyridine, wherein the amino or the pyridine group is quaternized and a salt is formed.

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The International Publication WO0040630 (Ciba) relates to a composition containing ATRP polymers and dispersible inorganic or organic pigment particles. Examples are given for copolymers like poly(BA-b-DMAEA) quaternized with benzyl chloride or with para toluene sulfonic acid. Quaternized N-atom structures having a polar substituent are not disclosed.

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The International Publication WO03046029 (Ciba) relates to a composition containing modified block copolymer dispersants and dispersible inorganic or organic pigments. The block copolymers are prepared by atom transfer radical polymerisation (ATRP) and modified with a salt forming group. The salt forming groups are specific monocyclic sulphonic acids or polycyclic sulphonic acids or mono- or polycyclic carboxylic and phosphonic acids. Quaternized N-atom structures having a polar substituent are not disclosed.

The European Patent Publication EP0329873 (DuPont) discloses block copolymers composed of acrylate or methacrylate monomers which exhibit substantially different polarity, one of the blocks having cationic ammonium, phosphonium or sulfonium moieties. Disclosed is, for example, a methyl methacrylate--dimethylaminoethylmethacrylate (DMAEMA)-co-polymer quaternized with benzylchloride.

The Japanese publication JP2002031713 (Mitsubishi) provides a color filter containing a binder resin and/or a compound having a polymerizable group, provided with an acidic group (1), a pigment (2) and a dispersing agent (3). The dispersing agent is an A-B block copolymer consisting of an A block with a quaternary ammonium salt in a side chain and a B block with no quaternary ammonium base and/or a B-A-B block copolymer.

The US Publication US6'100'312 (Fuji) discloses a radiation sensitive colored composition comprising (A) a copolymer which comprises a quaternary ammonium salt monomer; (B) a radiation sensitive compound; and (C) a pigment: which can provide a color filter having excellent pattern reproducibility because of its high suitability for dispersion of fine-grain pigment and its high storage stability. Any monomer can be used as a quaternary ammonium salt monomer. Specific examples of such a monomer include:

methacryloyloxyethyltrimethylammonium p-toluenesulfonate,
methacryloyloxyethyltrimethylammonium chloride,
methacryloyloxyethyldimethylethylammonium p-toluenesulfonate,
methacryloyloxyethyldimethylisopropylammonium p-toluenesulfonate,
acryloyloxyethyltrimethylammonium p-toluenesulfonate,
dimethyloctadecylvinylbenzylammonium chloride,
2-vinyl-N-methylpyridinium methylsulfate,
N-methyl-N-methacryloyloxyethylpiperidinium bromide and
N-methacryloyloxyethylpiperidinium nitrate.

The above prior art publications comprise mainly a salt structure with conventional aliphatic and aromatic hydrocarbon on the amino group.

Surprisingly, we recently found that using a copolymer having monomer units containing a quaternized N-atom structure with a polar substituent, results in novel salt modified dispersants which show better dispersing performance and development properties compared with the conventional salt formed dispersant in color filter application.

Thus, the invention relates to a copolymer made by controlled polymerisation or by conventional polymerization comprising

at least one monomer (MA_r) selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers,

- 5 **at least one monomer (MB_s)** selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers wherein the monomer **MB** has a quaternized **N-atom** structure with a **polar substituent** selected from polyether, polyamine, nitrile, amide, imine, imide, ester, ketone, nitrile, aldehyde, diketone, ketoester, ketoamide, carbonate, carbamate, carbamide, sulfoxide, sulfone, carboxylic acid,
 10 sulfonic acid, phosphoric acid groups; or carboxylic acid anion, sulfonic acid anion or phosphoric acid anion groups which is formed as betaine structure

r denotes the total number of monomers MA within the structural element (MA_r) and r is > 5, preferred 10-1000, most preferred 10-500;

- s denotes the total number of monomers MB within the structural element (MB_s) and
 15 s is > 1, preferred 2-100, most preferred 2-50. Claim 1

In one embodiment the polymer is obtained by conventional polymerisation by reacting monomer MA with monomer MB in the presence of a free radical initiator selected from inorganic and organic peroxides, hydroperoxides, persulfates, azo compounds such as
 20 azobisisobutyronitrile (AIBN) and the like.

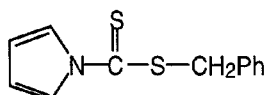
In one embodiment the polymer is produced by controlled polymerisation.

Examples of controlled polymerizations are:

- Group transfer polymerisation (GTP) as described, for example, in US4'656'226.
- 25 • The reversible addition-fragmentation chain transfer polymerisation RAFT using chain transfer agents which react by reversible addition-fragmentation chain transfer as described, for example, in WO-A-98/01478, WO-A-99/05099 or WO-A-99/31144.
- Atom transfer radical polymerisation (ATRP) as, for example, described in WO96/30421.
- 30 • Polymerization in the presence of alkoxyamine initiator/regulator compounds as described, for example, in US 4'581'429 or EP-A-0 621 878 or polymerization in the presence of a stable nitroxyl free radical and a radical initiator (source of free radicals) as described, for example, in WO-A-94/11412 (nitroxide mediated controlled polymerisation).

RAFT describes a method of polymer synthesis by radical polymerization in the presence of a free radical source and using chain transfer agents which react by reversible addition-fragmentation chain transfer. The chain transfer agent is, for example,

- 5
- 2-phenylprop-2-yl dithiobenzoate ($\text{Ph}-\text{C}(\text{CH}_3)_2-\text{S}-\text{C}(\text{S})-\text{Ph}$) or benzyl dithioacetate $\text{Ph}-\text{CH}_2-\text{S}-\text{C}(\text{S})-\text{CH}_3$ as described in WO-A-98/01478, or
 - a carbamates such as, for example, benzyl 1-pyrrolicarbodithioate



as described in WO99/31144; or

- 10
- alkylxanthates such as, for example, ethyl α (O-ethylxanthyl propionate) as described in WO 98/58974

WO 96/30421 (K. Matyjaszewski) discloses a controlled polymerisation process of ethylenically unsaturated polymers, such as styrene or (meth)acrylates, by employing the **Atomic Transfer Radical Polymerisation (ATRP)** method. This method produces defined homopolymers and copolymers, including block copolymers. Initiators are employed, which generate radical atoms, such as $\bullet\text{Cl}$, in the presence of a redox system of transition metals of different oxidation states, e.g. Cu(I) and Cu(II) , providing "living" or controlled radical polymerisation.

20 Definitions:

The monomer MA is selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers.

25 The **copolymer MA-MB** build up of monomers MA and monomers MB may include different kinds of monomers MA and different kinds of monomers MB. The term "selected from" means selected from one of the monomers listed or selected from more than one of the monomers listed.

The Monomer MA is not a salt.

30

Monomers MA are selected from $\text{CH}_2=\text{CH}-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{C}(\text{CH}_3)-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{C}(\text{R}_1)-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{CH}-\text{C}(\text{O})\text{NR}_4\text{R}_5$, $\text{CH}_2=\text{C}(\text{CH}_3)-\text{C}(\text{O})\text{NR}_4\text{R}_5$, $\text{CH}_2=\text{C}(\text{R}_1)-\text{C}(\text{O})\text{NR}_4\text{R}_5$ or $\text{CH}_2=\text{C}(\text{R}_{10})-\text{Ar}$, wherein

- R₁** is halogen or cyano or **R₁** is C₁-C₁₈alkyl, C₂-C₁₈alkenyl, C₃-C₁₈cycloalkyl, C₄-C₁₈cycloalkenyl, C₆-C₂₄aryl, C₁-C₁₂alkyl-C₆-C₂₄aryl or C₂-C₁₂alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen or **OR₃**, **SR₃** or **NR₄R₅**; and/or optionally is interrupted by one or more -O-, -S-, -NR₄-,
- 5 **R₂** is hydrogen; or **R₂** is C₁-C₄₀alkyl, C₂-C₄₀alkenyl, C₃-C₄₀cycloalkyl, C₄-C₄₀cycloalkenyl, C₆-C₂₄aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen, **OR₃**, **SR₃**, **NR₄R₅**, NH-CO-**OR₂₀** with **R₂₀** is -C₂-C₆alkylene-**NR₄R₅** or is a polyester residue and/or optionally is interrupted by one or more -O-, -S-, -NR₄-, -C(O)-, -C(O)O-, -C(O)NR₄- or -OC(O)NR₄-
- 10 **R₃** is hydrogen; or **R₃** is C₁-C₂₀alkyl, C₂-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₂₄aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen, OC₁-C₁₂alkyl, SC₁-C₁₂alkyl or **NR₄R₅**; and/or each of which is optionally interrupted by one or more -O-, -C(O)-, -C(O)O-, -S-, -NR₄-,
- 15 **R₄, R₅** independently of each other are hydrogen; or **R₄, R₅** independently of each other are C₁-C₂₀alkyl, C₂-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₁₈aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen, **OR₃**, **SR₃**, C(O)**R₃**, N(C₁-C₁₂alkyl)₂; and/or optionally is interrupted by one or more -O-, -S-, -C(O)- or -NC₁-C₁₂alkyl; **R₄** and **R₅** can optionally
- 20 form 5-, 6- or 7-membered rings with each other;
- R₁₀** is hydrogen, halogen or cyano; or **R₁₀** is C₁-C₁₈alkyl, C₂-C₁₈alkenyl, C₃-C₁₈cycloalkyl, C₄-C₁₈cycloalkenyl, C₆-C₂₄aryl, C₁-C₁₂alkyl-C₆-C₂₄aryl or C₂-C₁₂alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen or **OR₃**, **SR₃** or **NR₄R₅**; and/or optionally is interrupted by one or more -O-, -S-, -NR₄-,
- 25 **Ar** is pyridyl or imidazolyl, or C₆-C₂₄aryl which optionally is substituted by one or more halogen, C₁-C₂₀alkyl, C₂-C₂₀alkenyl, **OR₃**, **SR₃**, **NR₄R₅**, C(O)**R₃**, C(O)**OR₃**, C(O)**SR₃** or C(O)N **R₄R₅**. (claim 2)
- 30 **At least one monomer (MA_r)** means that also two or more monomers MA may be present in the copolymer. Preferred are one or two monomers MA.

Preferred monomers MA

Preferred are $\text{CH}_2=\text{CH}-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{C}(\text{CH}_3)-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{CH}-\text{C}(\text{O})\text{NR}_4\text{R}_5$, $\text{CH}_2=\text{C}(\text{CH}_3)-\text{C}(\text{O})\text{NR}_4\text{R}_5$ or $\text{CH}_2=\text{CH}-\text{Ar}$ wherein R_2 , R_4 , R_5 and Ar are as defined above. (claim 3)

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R_2 is preferably linear or branched $\text{C}_1\text{-C}_{40}$ alkyl, or $\text{C}_1\text{-C}_{40}$ alkyl substituted by one or more halogen, OH , $-\text{N}(\text{C}_1\text{-C}_{20}\text{alkyl})_2$, $-\text{NH}-\text{CO}-\text{O}-\text{C}_2\text{-C}_6\text{alkylene}-\text{N}(\text{C}_1\text{-C}_{20}\text{alkyl})_2$, $-\text{NH}-\text{CO}-\text{O}-\text{C}_1\text{-C}_{40}\text{alkylene}$ interrupted by one or more $-\text{O}-$.

10 Ar is preferably phenyl, tolueneyl, pyridyl, imidazolyl. (claim 4)

Examples of preferred monomers MA are:

styrene, p-vinyltoluene, vinylpyridine, vinylimidazole;

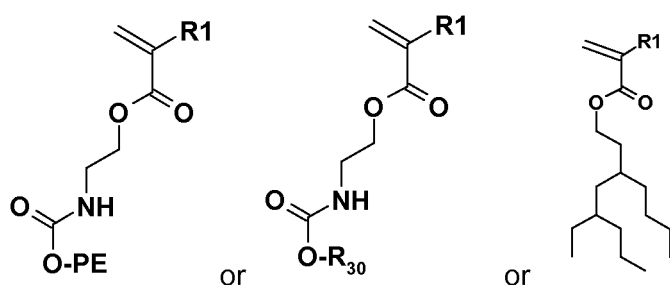
methylacrylate, ethylacrylate, butylacrylate, isobutylacrylate, tert-butylacrylate, hydroxyethylacrylate, hydroxypropylacrylate, dimethylaminoethylacrylate, ethylhexylacrylate, benzylacrylate, polyethyleneglycolmonomethyletheracrylate, cyclohexylacrylate, acrylic acid,

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methyl(meth)acrylate, ethyl(meth)acrylate, butyl(meth)acrylate, isobutyl(meth)acrylate, tert-butyl(meth)acrylate, hydroxyethyl(meth)acrylate, hydroxypropyl(meth)acrylate, dimethylaminoethyl(meth)acrylate, ethylhexyl(meth)acrylate, benzyl(meth)acrylate, polyethylene-

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glycolmonomethylether(meth)acrylate, cyclohexyl(meth)acrylate, (meth)acrylic acid,

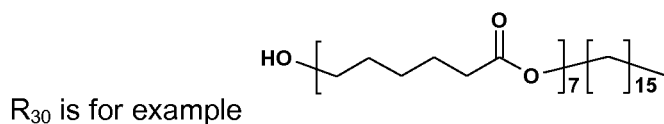


wherein R_1 is hydrogen or methyl and

PE is $\text{C}_{10}\text{-C}_{40}$ alkyl or $\text{C}_{10}\text{-C}_{40}$ alkenyl each of which is interrupted by one or more $-\text{O}-$ or $-\text{C}(\text{O})\text{O}-$;

25

R_{30} is $-\text{C}_2\text{-C}_6\text{alkylene}-\text{N}(\text{C}_1\text{-C}_2\text{alkyl})_2$ or is a polyester residue derived from a caprolactone.



The monomer **MB** is selected from unsaturated monomers out of the group of acrylates, methacrylates, derivatives of acrylates, acrylamides, methacrylamides, derivatives of acrylamides, styrenic monomers. The monomer **MB** must have a quaternized **N-atom** structure with a **polar substituent**.

At least one monomer (**MB_s**) means that also two or more monomers **MB** may be present in the copolymer. Preferred are one or two monomers **MB**.

The monomer **MB** has the general formula $\text{CH}_2=\text{C}(\text{R}_{11})-\text{W}-\text{YZ}$ wherein

R₁₁ is hydrogen, halogen or cyano; or **R₁₁** is **C₁-C₁₈alkyl**, **C₂-C₁₈alkenyl**, **C₃-C₁₈cycloalkyl**, **C₄-C₁₈cycloalkenyl**, **C₆-C₂₄aryl**, **C₁-C₁₂alkyl-C₆-C₂₄aryl** or **C₂-C₁₂alkenyl-C₆-C₂₄aryl** each of which optionally is substituted by one or more halogen or **OR₃**, **SR₃** or **NR₄R₅**; and/or optionally is interrupted by one or more **-O-**, **-S-**, **-NR₄-**;

R₃ is hydrogen; or **R₃** is **C₁-C₂₀alkyl**, **C₂-C₂₀alkenyl**, **C₃-C₂₀cycloalkyl**, **C₄-C₂₀cycloalkenyl**, **C₆-C₂₄aryl**, **C₁-C₂₀alkyl-C₆-C₂₄aryl** or **C₂-C₂₀alkenyl-C₆-C₂₄aryl** each of which optionally is substituted by one or more halogen, **OC₁-C₁₂alkyl**, **SC₁-C₁₂alkyl** or **NR₄R₅**; and/or each of which is optionally interrupted by one or more **-O-**, **-C(O)-**, **-C(O)O-**, **-S-**, **-NR₄-**

R₄, R₅ independently of each other are hydrogen; or **R₄, R₅** independently of each other are **C₁-C₂₀alkyl**, **C₂-C₂₀alkenyl**, **C₃-C₂₀cycloalkyl**, **C₄-C₂₀cycloalkenyl**, **C₆-C₁₈aryl**, **C₁-C₂₀alkyl-C₆-C₂₄aryl** or **C₂-C₂₀alkenyl-C₆-C₂₄aryl** each of which optionally is substituted by one or more halogen, **OR₃**, **SR₃**, **C(O)R₃**, **N(C₁-C₁₂alkyl)₂**; and/or optionally is interrupted by one or more **-O-**, **-S-**, **-C(O)-** or **-NC₁-C₁₂alkyl-I**; **R₄** and **R₅** can be optionally form 5-, 6- or 7-membered rings with each other and/or **R₃** or **R₆**

W is direct bond or **C(O)-X**; or **W** is **C₁-C₁₆alkylene**, **C₁-C₁₆alkenylene**, **C₆-C₁₈arylene**, each of which optionally is interrupted by one or more **-O-**, **-S-**, **-NR₄-**,

X is **OC₁-C₁₆alkylene**, **OC₁-C₁₆alkenylene**, **-OC₁-C₁₆alkylene-NH-CO-OC₁-C₁₆alkylene**, **-SC₁-C₁₆alkylene**, **-SC₁-C₁₆alkenylene**, **-NR₄C₁-C₁₆alkylene**, **-NR₄C₁-C₁₆alkenylene**, **-OC₆-C₁₈arylene**, **-SC₆-C₁₈arylene**, **-NR₄C₆-C₁₈arylene** each of which optionally is interrupted by one or more **-O-**, **-S-**, **-NR₄-**, **-NR₄C(O)O-**, **-NR₄C(O)S-** or **-NR₄C(O)NR₄-**

- 9 -

Y is C₂-C₂₄cyclicammonium⁺-R₆ or N⁺R₄R₅R₆

R₆ is C₁-C₂₀alkyl, C₁-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₁₈aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which is **substituted** one or more than once by CN, O[C₂-C₈alkyleneO]_mR₃, S[C₂-C₈alkyleneO]_mR₃, O[C₂-C₈alkyleneS]_mR₃, O[C₂-C₈alkyleneN]_mR₄R₅, NR₄R₅[C₂-C₈alkyleneN]_mR₄R₅, C(O)R₃, C(O)OR₃, C(O)SR₃, C(O)NR₄R₅, S(O)R₃, S(O)₂R₃, S(O)₂OR₃, S(O)₂NR₄R₅, OS(O)₂R₃, OS(O)₂OR₃, P(O)(OR₃)₂, OP(O)(OR₃)₂, OC(O)R₃, OC(O)OR₃, OC(O)SR₃, OC(O)NR₄R₅, SC(O)OR₃, SC(O)SR₃, SC(O)NR₄R₅, NR₄C(O)R₃, NR₄C(O)OR₃, NR₄C(O)SR₃, NR₄C(O)NR₄R₅, C(O)C(O)R₃, C(O)C(O)OR₃, C(O)C(O)SR₃, C(O)C(O)NR₄R₅, C(O)O⁻, S(O)₂O⁻ or P(O)OR₃O⁻, **provided that** if R₆ is C₁-C₂₀alkyl, C₁-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₁₈aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which is substituted by one or more C(O)O⁻, S(O)₂O⁻ or P(O)OR₃O⁻, Z is not existing.

Z is PF₆⁻, BF₄⁻, OH⁻, F⁻, Cl⁻, Br⁻ or I⁻; or **Z** is C₁-C₄₀alkyl[C(O)O⁻]_n, C₁-C₄₀alkenyl[C(O)O⁻]_n, C₃-C₄₀cycloalkylC(O)O⁻, C₄-C₄₀cycloalkenylC(O)O⁻, C₆-C₂₄aryl[C(O)O⁻]_n, C₁-C₄₀alkyl[S(O)₂O⁻]_n, C₁-C₄₀alkenyl[S(O)₂O⁻]_n, C₃-C₄₀cycloalkylS(O)₂O⁻, C₄-C₄₀cycloalkenylS(O)₂O⁻, C₆-C₂₄aryl[S(O)₂O⁻]_n, C₁-C₄₀alkyl[P(O)OR₃O⁻]_n, C₁-C₄₀alkenyl[P(O)OR₃O⁻]_n, C₃-C₄₀cycloalkylP(O)OR₃O⁻, C₄-C₄₀cycloalkenylP(O)OR₃O⁻ or C₆-C₂₄aryl[P(O)OR₃O⁻]_n each of which optionally is interrupted by one or more -O-, -S-, -NR₄-, -C(O)-, -C(O)O-, -C(O)S-, -C(O)NR₄-, -OC(O)O-, -SC(O)O-, -SC(O)S-, -SC(O)NR₄-, -OC(O)NR₄- or -NR₄C(O)NR₄-;

m is >1, preferred 1-120, most preferred 1-40,

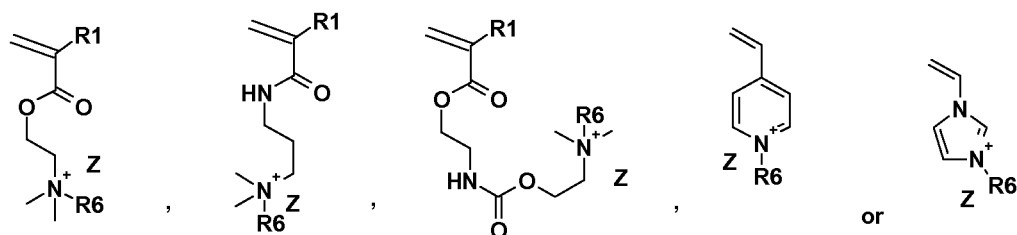
n is >1, preferred 1-5, most preferred 1-2. (claim 5)

Preferred monomers MB

MB has preferably the general formula CH₂=CH-**W**-**YZ** or CH₂=C(CH₃)-**W**-**YZ** wherein W is a direct bond or C(O)X and X is -OC₁-C₁₆alkylene or -OC₁-C₁₆alkylene-NH-CO-OC₁-C₁₆alkylene or is -NHC₁-C₁₆alkylene. (claim 6)

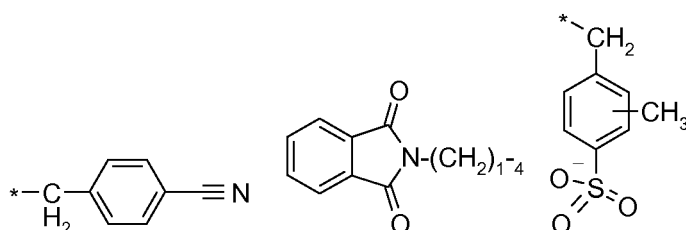
- 10 -

Examples of preferred monomers MB are:



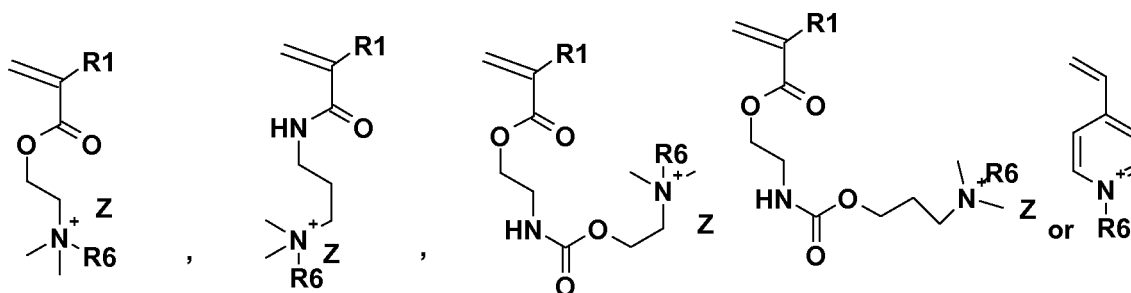
wherein R₁ is hydrogen or methyl and

R₆ is $-(CH_2)_{1-18}CN$, $-(CH_2)_{1-18}SO_3^-$, $-(CH_2)_{1-18}C(O)O^-$, $-CH_2-O[C_2-C_8alkyleneO]_mH$, $-CH_2C(O)CH_3$, $-CH_2CHO$, $-CH_2C(O)OC_1-C_{18}alkyl$, $-CH_2C(O)OH$, $-CH_2C(O)NH_2$, $-CH_2C(O)N(C_1-C_{18}alkyl)_2$, $-CH_2C(O)C(O)OC_1-C_{18}alkyl$, $-CH_2C(O)CH_2C(O)OC_1-C_{18}alkyl$, $-CH_2CH_2NHC(O)NH_2$, or



Z is Cl⁻, Br⁻ or I⁻; or Z is C₁-C₄₀alkylC(O)O⁻, C₁-C₄₀alkenylC(O)O⁻, C₆-C₁₀arylC(O)O⁻, C₁-C₄₀alkylS(O)₂O⁻, C₁-C₄₀alkenylS(O)₂O⁻, C₆-C₁₀arylS(O)₂O⁻, C₁-C₄₀alkylP(O)OR₃O⁻ each of which optionally is interrupted by one or more -O-. claim 7

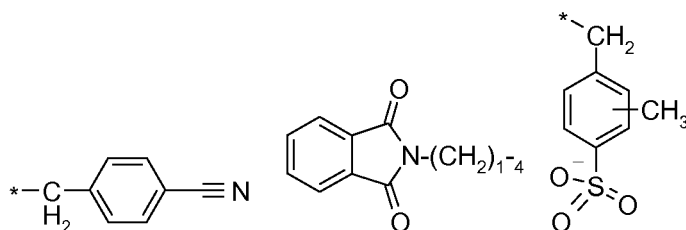
Examples of especially preferred monomers MB are:



wherein R₁ is hydrogen or methyl and

R₆ is $-CH_2CN$, $-CH_2OCH_2CH_2OCH_3$, $-CH_2CH_2OCH_2CH_2OCH_3$, $-CH_2C(O)CH_3$, $-CH_2CHO$, $-CH_2COOH$, $CH_2C(O)OCH_2CH_3$, $-CH_2C(O)NH_2$, $-CH_2C(O)N(CH_3)_2$, $-CH_2C(O)N(C_2H_5)_2$, $CH_2C(O)C(O)OCH_2CH_3$, $CH_2C(O)C(O)OCH_3$, $CH_2CH_2NHC(O)NH_2$, $CH_2CH_2CH_2SO_3^-$ or $CH_2CH_2CH_2CH_2SO_3^-$

- 11 -



Z is Cl⁻, Br⁻ or I⁻;

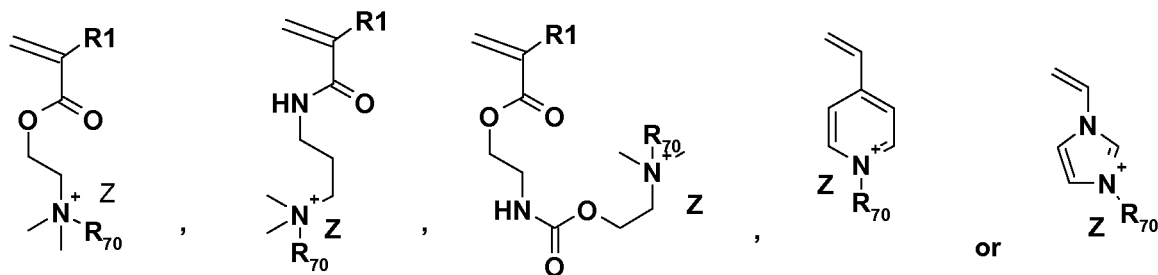
5

The copolymer **MA_r-MB_s** may optionally contain further monomers **MB'_s**, of the general formula CH₂=C(R₁₁)-W-Y'Z which are salts but do not have a polar substituent.

In one embodiment the copolymer **MA_r-MB_s** comprises further monomers **MB'_s**, of the general formula CH₂=C(R₁₁)-W-Y'Z

10

Preferred monomers MB'_s, are the general formula CH₂=C(R₁₁)-W-Y'Z are

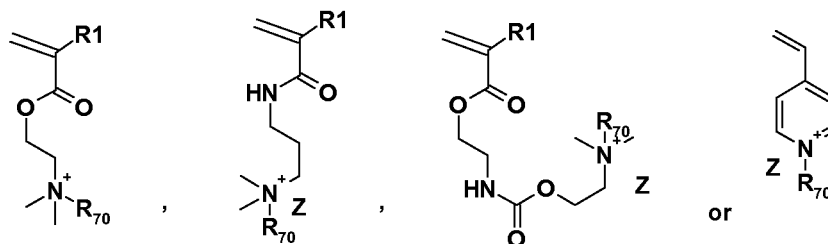


15 wherein R₁ is hydrogen or methyl and

R₇₀ is hydrogen, benzyl, o-chlorobenzyl, o,p-chlorobenzyl, 1-naphtyl, C₁-C₄alkyl, C₁-C₄alkenyl

Z is Cl⁻, Br⁻ or I⁻; or **Z** is C₁-C₄₀alkylC(O)O⁻, C₁-C₄₀alkenylC(O)O⁻, C₆-C₁₀arylC(O)O⁻, C₁-C₄₀alkylS(O)₂O⁻, C₁-C₄₀alkenylS(O)₂O⁻, C₆-C₁₀arylS(O)₂O⁻, C₁-C₄₀alkylP(O)OR₃O⁻ each of which optionally is interrupted by one or more -O-.

Especially preferred monomers MB's' of the general formula $\text{CH}_2=\text{C}(\text{R}_{11})-\text{W}-\text{Y}'\text{Z}$ are



wherein

R_1 is hydrogen or methyl

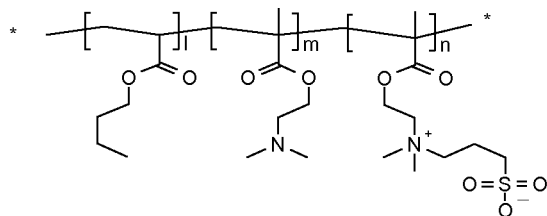
5 R_{70} is hydrogen, benzyl, o-Chloribenzyl

Z is Cl^- , Br^- or I^- ; or **Z** is $\text{C}_1\text{-C}_{40}\text{alkylC}(\text{O})\text{O}^-$, $\text{C}_1\text{-C}_{40}\text{alkenylC}(\text{O})\text{O}^-$, $\text{C}_1\text{-C}_{40}\text{alkylS}(\text{O})_2\text{O}^-$, $\text{C}_1\text{-C}_{40}\text{alkenylS}(\text{O})_2\text{O}^-$, $\text{C}_1\text{-C}_{40}\text{alkylP}(\text{O})\text{OR}_3\text{O}^-$ each of which optionally is interrupted by one or more $-\text{O}-$.

10

The proviso

The proviso is necessary because of technical reasons. If R_6 is for example $-(\text{CH}_2)_3\text{-SO}_3^-$ then the ammonium cation already has a counter-anion. An example is:



15

Preferred is a copolymer as described above and made by controlled polymerization (claim 6)

20 Especially preferred a copolymer as described above and made by nitroxide mediated controlled polymerization resulting in copolymers



wherein

(MA_r) and (MB_s) are as defined above

25 **In** is an initiator fragment capable to initiate radical polymerisation,

E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the polymer or copolymer; or a group which results from a substitution or elimination reaction of the attached stable free nitroxyl radical,

$$z = \geq 1$$

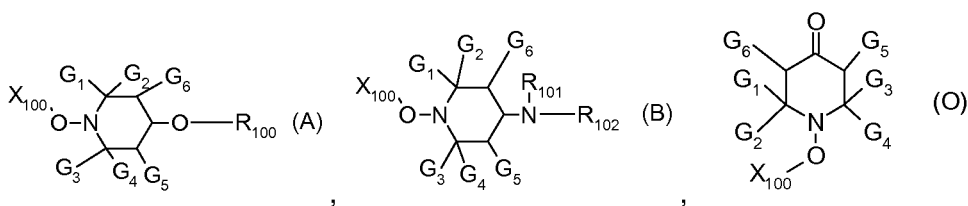
5 **t** = 1 to 20.

(claim 6)

The initiator IN-E

10 All the initiators N-O-X as disclosed in WO 2005 059048 are suitable.

E-In is preferably of formula A, B or O



wherein

15 R_{100} is hydrogen, C_1 - C_{18} alkyl which is uninterrupted or interrupted by one or more oxygen atoms, cyanoethyl, benzoyl, glycidyl, a monovalent radical of an aliphatic carboxylic acid having 2 to 18 carbon atoms, of a cycloaliphatic carboxylic acid having 7 to 15 carbon atoms, or an α,β -unsaturated carboxylic acid having 3 to 5 carbon atoms or of an aromatic carboxylic acid having 7 to 15 carbon atoms;

20 R_{101} is C_1 - C_{12} alkyl, C_5 - C_7 cycloalkyl, C_7 - C_8 aralkyl, C_2 - C_{18} alkanoyl, C_3 - C_5 alkenoyl or benzoyl;

R_{102} is C_1 - C_{18} alkyl, C_5 - C_7 cycloalkyl, C_2 - C_8 alkenyl unsubstituted or substituted by a cyano, carbonyl or carbamide group, or is glycidyl, a group of the formula $-\text{CH}_2\text{CH}(\text{OH})-\text{Z}$ or of the formula $-\text{CO}-\text{Z}$ or $-\text{CONH}-\text{Z}$ wherein Z is hydrogen, methyl or phenyl;

G_6 is hydrogen,

25 G_5 is hydrogen or C_1 - C_4 alkyl,

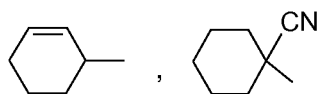
G_1 and G_3 are methyl,

G_2 and G_4 are ethyl or propyl or G_1 and G_2 are methyl and G_3 and G_4 are ethyl or propyl; and

X_{100} is selected from the group consisting of

- 14 -

-CH₂-phenyl, CH₃CH-phenyl, (CH₃)₂C-phenyl, (C₅-C₆cycloalkyl)₂CCN, (CH₃)₂CCN,



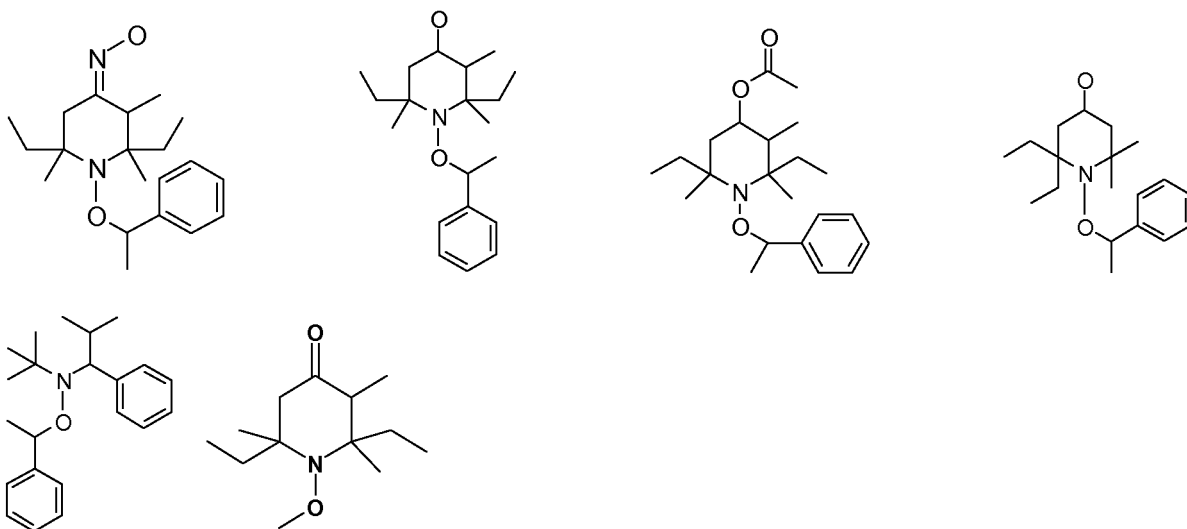
, -CH₂CH=CH₂, CH₃CH-CH=CH₂ (C₁-C₄alkyl)CR₂₀-C(O)-phenyl, (C₁-C₄)alkyl-CR₂₀-C(O)-(C₁-C₄)alkoxy, (C₁-C₄)alkyl-CR₂₀-C(O)-(C₁-C₄)alkyl, (C₁-C₄)alkyl-CR₂₀-C(O)-N-di(C₁-C₄)alkyl, (C₁-C₄)alkyl-CR₂₀-C(O)-NH(C₁-C₄)alkyl, (C₁-C₄)alkyl-CR₂₀-C(O)-NH₂, wherein R₂₀ is hydrogen or (C₁-C₄)alkyl.

5

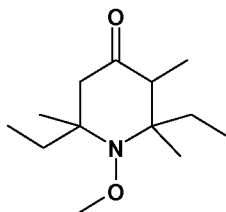
The above compounds and their preparation are described in G 2335190 and GB 2 361 235.

Preferred initiators are:

10

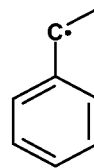


15 An especially preferred Initiator is

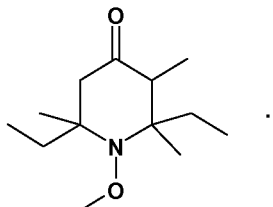


- 15 -

In this case the initiating fragment (In) in formula (I) is



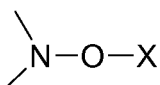
and the group (E) is



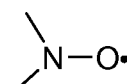
- 5 The initiator IN-E comprises the nitroxyl radical E and the initiator fragment In and is derived from the polymerisation reaction which is nitroxyl mediated controlled polymerization.

There are essentially two suitable routes:

b1) polymerization in the presence of alkoxyamine initiator/regulator compounds having the

structural element  ; and

- 10 b2) polymerization in the presence of a stable nitroxyl free radical having the structural

element  and a radical initiator (source of free radicals). Claim 8

The initiator IN-E may also be derived from **A**tom **t**ransfer radical **p**olymerization (ATRP).

15

In one embodiment the invention refers to a coating composition comprising:

- a) film forming binder resin, and
 b) a copolymer as described in any one of claims **1-8**,
 20 c) optional other conventional coating components and/or additives.

The film forming binder a) is selected from:

Solvent based resins, water based resins, emulsion polymers, solution polymers. The resins comprise all kinds of crosslinking mechanism and coating systems based on 1 component (1p) as well as 2p and multi component systems, e.g. thermosetting resins, room temperature curable resins, radiation-curable resins. Also included are physically drying coating systems like thermoplastic acrylic resins.

The resins comprise state of the art polymer chemistry used in coatings: e.g. saturated polyesters, unsaturated polyesters, polyacrylates, styrene-acrylic resins, polyurethanes, epoxy resins, nitrocellulose resins, hybrid systems like polyester/polyurethanes, polyacrylate/polyurethanes, alkyd/melamine, polyester/CAB/melamine, polyacrylate/CAB/melamine, etc.

Conventional coating components and/or additives are pigments; crosslinking agents; commercial levelling agents; photoinitiators; photosensitizers; degassing agents; optical brighteners; benzoin; flow modifiers; anti-blocking agents; ultraviolet absorbers; antistatic agents; antioxidants; agents to improve scratch resistance and the like.

The novel copolymers are especially useful in color filter application.

In one embodiment the color filter composition is comprising

- a) photo resist binder,
- b) transparent pigment,
- c) optionally a solvent and/or optionally a photoinitiator or a photolatent catalyst,
- d) dispersant which is copolymer of claim 1-8

The term photo resist binder refers to a photosensitive resin which is preferably an acid-curable resin or a photo curable resin such as acrylate, photo curable acrylate oligomer, polyester, alkyd, melamine, urea, epoxy and phenolic resins or mixtures thereof. Acid-curable resins of that kind are generally known and are described, for example, in "Ullmann's Encyclopdie der technischen Chemie", Edition 4, Vol. 15 (1978), pp. 613-628.

Preferred are (meth)acrylate/(meth)acrylic acid copolymers.

Preferable examples of copolymers are copolymers of methyl (meth)acrylate and (meth)acrylic acid, copolymers of benzyl (meth)acrylate and (meth)acrylic acid, copolymers of methyl (meth)acrylate/, ethyl (meth)acrylate and (meth)acrylic acid, copolymers of benzyl

(meth)acrylate, (meth)acrylic acid and styrene, copolymers of benzyl (meth)acrylate, (meth)acrylic acid and 2-hydroxyethyl (meth)acrylate, copolymers of methyl (meth)acrylate/, butyl (meth)acrylate, (meth)acrylic acid and styrene, copolymers of methyl (meth)acrylate, benzyl (meth)acrylate, (meth)acrylic acid and hydroxyphenyl (meth)acrylate, copolymers of

5 methyl (meth)acrylate, (meth)acrylic acid and polymethyl (meth)acrylate macromonomer, copolymers of benzyl (meth)acrylate, (meth)acrylic acid and polymethyl (meth)acrylate macromonomer, copolymers of tetrahydrofurfuryl (meth)acrylate, styrene and (meth)acrylic acid, copolymers of methyl (meth)acrylate, (meth)acrylic acid and polystyrene macro-

10 monomer, copolymers of benzyl (meth)acrylate, (meth)acrylic acid and polystyrene macro- monomer, copolymers of benzyl (meth)acrylate, (meth)acrylic acid, 2-hydroxyethyl (meth)- acrylate and polystyrene macromonomer, copolymers of benzyl (meth)acrylate, (meth)acrylic acid, 2-hydroxypropyl (meth)acrylate and polystyrene macro monomer, copolymers of benzyl (meth)acrylate, (meth)acrylic acid, 2-hydroxy-3-phenoxypropyl (meth)acrylate and polymethyl (meth)acrylate macromonomer, copolymers of methyl (meth)acrylate, (meth)acrylic acid, 2-

15 hydroxyethyl (meth)acrylate and polystyrene macromonomer, copolymers of benzyl (meth)- acrylate, (meth)acrylic acid, 2-hydroxyethyl (meth)acrylate and polymethyl (meth)acrylate macromonomer, copolymers of N- phenylmaleimide, benzyl (meth)acrylate, (meth)acrylic acid and styrene, copolymers of benzyl (meth)acrylate, (meth)acrylic acid, N-phenyl- maleimide, mono-[2- (meth)acryloyloxyethyl] succinate and styrene, copolymers of allyl

20 (meth)acrylate, (meth)acrylic acid, N-phenylmaleimide, mono-[2-(meth)acryloyloxyethyl] succinate and styrene, copolymers of benzyl (meth)acrylate, (meth)acrylic acid, N-phenyl- maleimide, glycerol mono(meth)acrylate and styrene, copolymers of benzyl (meth)acrylate, [omega]- carboxypolycaprolactone mono(meth)acrylate, (meth)acrylic acid, N-phenyl- maleimide, glycerol mono(meth)acrylate and styrene, and copolymers of benzyl (meth)-

25 acrylate, (meth)acrylic acid, N-cyclohexylmaleimide and styrene.

A photo curable acrylate oligomer is preferably present in addition to the photo curable resin. Photo curable acrylate oligomers usable herein include dipentaerythritol hexaacryl (DPHA), dipentaerythritol pentaacrylate (DPPA), pentaerythritol triacrylate (PETTA), trimethylol-

30 propane triacrylate (TMPTA), and trimethylolpropane triacrylate (TMPTA) and the like.

The term transparent pigment refers to a pigment which gives a transparently colored ink when dispersed.

The pigment may be inorganic or preferably organic, for example carbon black or pigments of the 1-aminoanthraquinone, anthanthrone, anthrapyrimidine, azo, azomethine, quinacridone, quinacridonequinone, quinophthalone, dioxazine, diketopyrrolopyrrole, flavanthrone, indanthrone, isoindoline, isoindolinone, isoviolanthrone, perinone, perylene, phthalocyanine, pyranthrone or thioindigo series, including those, where applicable, in the form of metal complexes or lakes, in particular unsubstituted or partially halogenated phthalocyanines such as copper, zinc or nickel phthalocyanines, 1,4-diketo-3,6-diaryl-pyrrolo[3,4-c]pyrroles, dioxazines, isoindolinones, indanthrones, perylenes and quinacridones. Azo pigments may be, for example, mono- or dis-azo pigments from any known sub-class, obtainable, for example, by coupling, condensation or lake formation.

Notably useful are the pigments described in the Colour Index, including Pigment Yellow 1, 3, 12, 13, 14, 15, 17, 24, 34, 42, 53, 62, 73, 74, 83, 93, 95, 108, 109, 110, 111, 119, 120, 123, 128, 129, 139, 147, 150, 151, 154, 164, 168, 173, 174, 175, 180, 181, 184, 185, 188, 191, 191:1, 191:2, 193, 194 and 199; Pigment Orange 5, 13, 16, 22, 31, 34, 40, 43, 48, 49, 51, 61, 64, 71, 73 and 81; Pigment Red 2, 4, 5, 23, 48, 48:1, 48:2, 48:3, 48:4, 52:2, 53:1, 57, 57:1, 88, 89, 101, 104, 112, 122, 144, 146, 149, 166, 168, 170, 177, 178, 179, 181, 184, 185, 190, 192, 194, 202, 204, 206, 207, 209, 214, 216, 220, 221, 222, 224, 226, 242, 248, 254, 255, 262, 264, 270 and 272; Pigment Brown 23, 24, 25, 33, 41, 42, 43 and 44; Pigment Violet 19, 23, 29, 31, 37 and 42; Pigment Blue 15, 15:1, 15:2, 15:3, 15:4, 15:6, 16, 25, 26, 28, 29, 60, 64 and 66; Pigment Green 7, 17, 36, 37, 50 and 58 Pigment Black 7, 12, 27, 30, 31, 32, 37 and 582; Vat Red 74; 3,6-di(3',4'-dichloro-phenyl)-2,5-dihydro-pyrrolo[3,4-c]pyrrole-1,4-dione, 3,6-di(4'-cyano-phenyl)-2,5-dihydro-pyrrolo[3,4-c]pyrrole-1,4-dione and 3-phenyl-6-(4'-tert-butyl-phenyl)-2,5-dihydro-pyrrolo[3,4-c]pyrrole-1,4-dione; and mixtures and solid solutions thereof.

Solvent

Normally the compositions according to the invention are dissolved in a suitable solvent before application to the substrate. Examples of such solvents include ethylene dichloride, cyclohexanone, cyclopentanone, 2-heptanone, gamma-butyrolactone, methyl ethyl ketone, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, 2-methoxyethyl acetate, 3-methoxybutyl acetate, 2-ethoxyethyl acetate, 2-ethoxyethanol, diethyl glycol dimethyl ether, ethylene glycol mono-ethyl ether acetate, ethylene glycol monobutyl ether acetate, diethylene glycol monobutyl ether acetate, propylene glycol monomethyl ether, propylene

glycol monomethyl ether acetate, dipropylene glycol methyl ether acetate, toluene, ethyl acetate, methyl lactate, ethyl lactate, methylmethoxy propionate, ethylethoxy propionate, methyl pyruvate, ethyl pyruvate, propyl pyruvate, N,N-dimethyl-formamide, dimethyl sulfoxide, N-methylpyrrolidone and tetrahydrofuran. Such solvents can be used individually or in combinations. Preferred examples thereof are esters, such as 2-methoxyethyl acetate, ethylene glycol monoethyl ether acetate, propylene glycol monomethyl ether acetate, methylmethoxy propionate, ethylethoxy propionate and ethyl lactate.

Photoinitiator:

Any photoinitiator or photolatent catalyst may be used when desired. The photoinitiator or photolatent catalyst is not limited. Preferred are photoinitiators selected from

1. Alpha-hydroxyketones (AHK), alpha-alkoxyketones(benzildimethylketals DBK) and alpha-aminoketones (AAK),
2. Benzophenones,
3. Mono- and bisacylphosphine oxides (BAPO),
4. Phenyl-glyoxylates,
5. Isopropylthioxanthone (ITX),
6. Oxime-esters,
7. Aminobenzoates
8. Latent acids and bases and blends thereof.

The invention further relates to a method for producing a color filter, which comprises coating the color filter composition described above on a substrate, followed by exposure and development.

A "substrate" means any carrier material adapted to be coated with photoresist layers for the purpose of exposure. For this purpose frequently glass plates are used, which may be colored black or coated. Furthermore, plastic foils or metal foils that are already provided with a grating image, preferably in the form of an embossing, are suitable as substrates.

Examples of the coating of the photosensitive film include slit coating using a coating device having slit type nozzles, slit-and-spin coating that first coats using a nozzle and then coats

using a spin coater, die coating, and curtain flow coating. Of these coating methods, the slit-and-spin coating is preferred. After the coating, the photosensitive resin composition may be prebaked to remove volatile ingredients such as solvents, thereby forming the photosensitive resin film containing substantially no volatile ingredient. The photosensitive resin film may
5 have a thickness of about 1 to 10 μm .

Next, the photosensitive film is subjected to a first exposure through a mask. The mask has a pattern suitable for the function of the hardened resin pattern.

10 The photoresist resin film is then developed by puddle development, immersion development, or spray development. The development may be performed by using an alkaline aqueous solution. The alkaline aqueous solution contains an inorganic alkaline compound or an organic alkaline compound.

15 The copolymers are used as pigment dispersants. The pigment is preferably dispersed in an organic solvent.

The copolymers are especially used to prepare paints, printing inks, inkjet inks, color filters and color resists.

20

The invention further relates to the use of a copolymer according to claim 1- 9 to prepare paints, printing inks, inkjet inks, color resists and inkjet inks for color filters.

25 **Examples**

The following examples illustrate the invention.

Materials use and their abbreviations.

Monomers: Butylacrylate (BA),

Hydroxyethylacrylate (HEA),

30 hydroxypropylacrylate (HPA),

4-vinyl-pyridine (4-VP),

N,N-Dimethylaminoethylmethacrylate (DMAEMA),

N,N-Dimethylaminopropylmethacrylate (DMAPMA).

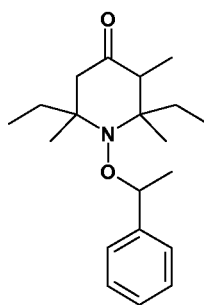
- 21 -

Modification agents: Benzylchloride (BnCl),
methoxy-poly-ethyleneglycole (MPEG 550-OH).

Solvents: methoxypropylacetate (MPA),
Xylene,
methoxypropanol (MP),
polystyrene (PS),
tetrahydrofurane (THF),
polyethyleneoxide (POE/PEG).

ATRP process: initiator is 2-bromoethylpropionate (MBP), the catalyst is CuBr/CuBr₂, the ligand is N,N,N',N'',N''-pentamethyldiethyltriamine (PMDETA).

NOR Initiator/regulator is compound O1



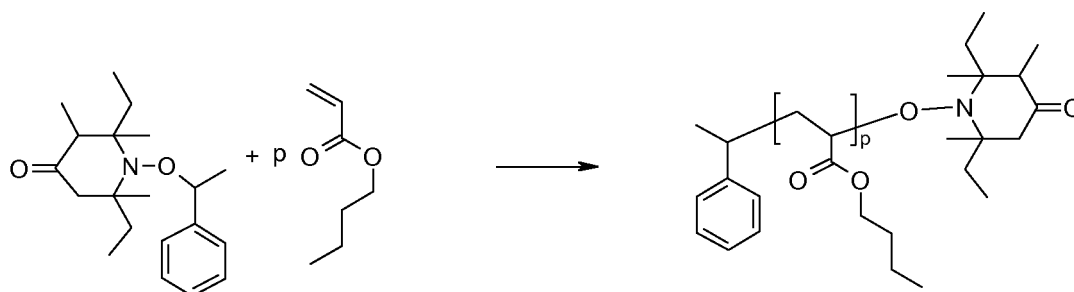
(O1), which is prepared according

to GB 2335190.

All other materials are commercially available and were used as received.

A) Preparation of Polymers and Copolymers

Example A1: Synthesis of a linear polymer poly(BA)



In a 3-necked 1000ml round bottom flask with magnetic stirring bar, cooler, thermometer, dropping funnel 150.10 g n-Butylacrylate (n-BA, 128.17g/mol), 8.55g compound O1 (317.48g/mol) and 122.13g of MPA were added, three times degassed with N₂/vacuum and

polymerized at 135°C under N₂ until a conversion of around 8 mol% is reached. 338.89 g of n-BA is slowly added to the reaction with the dropping funnel and polymerized at 135°C under N₂ until a conversion of around 48 mol%. Residual monomers and solvents were distilled off at 80°C and 12 mbar.

5

Yield 47%, GPC (THF, PS-Standard, Mn=7800 g/mol, PD=1.27), liquid.

Example A2: Synthesis of a block copolymer Poly(n-BA-b-DMAEMA)

10 In a 200ml flask equipped with a magnetic stirring bar and distillation column are loaded 80 g of A1 and 80g of N,N-Dimethylaminoethyl methacrylamide (DMAEMA) and were heated under N₂ to 145°C. After 2hours the reaction was terminated and non-reacted monomer DMAEMA was distilled off at high vacuum.

96g of block copolymer were isolated; GPC (THF, PS-Standard, Mn=11000 g/mol; PD=1.313), yellow viscous liquid

15

Example A3: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-o-ClBn)]Cl⁻ by quaternization

20 In a 100 mL flask equipped with a magnetic stirring bar and distillation column are loaded 14g of a Poly[n-BA-b-DMAEMA], 1.0g of o-Chlorobenzylchloride (o-ClBnCl) and 16 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4h.

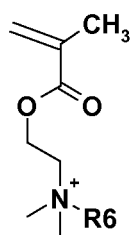
After the reaction, 31.0g of liquid polymer are obtained

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

25 Example A4: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-butylsulfonic acid anion)] by quaternization

MA is butylacrylate and DMAEMA

MB =



R6= -CH₂-CH₂-CH₂-CH₂-SO₃⁻

Z is not present

- 23 -

In a 100 mL flask equipped with a magnetic stirring bar and distillation column are loaded 14g of a Poly[n-BA-b-DMAEMA], 0.9g of 1,4-Butanesulfone and 16 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4h.

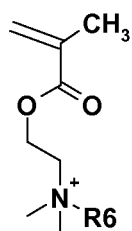
After the reaction, 30.9g of liquid polymer are obtained

- 5 $^1\text{H-NMR}$ and amine value measurement indicate quantitative conversion for quaternization.

Example A5: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-acetamidyl)]-I⁻ by quaternization

- 10 MA is butylacrylate and DMAEMA

MB=



R6 = -CH₂-CO-NH₂; Z is I⁻

In a 100 mL flask equipped with a magnetic stirring bar and distillation column are loaded 14g of a Poly[n-BA-b-DMAEMA], 0.9g of 2-Iodoacetamide and 16 g of 1-methoxy-2-propanol.

- 15 The mixture is heated to 95°C for 4h.

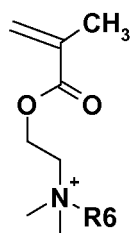
After the reaction, 20.9g of liquid polymer are obtained

$^1\text{H-NMR}$ and amine value measurement indicate quantitative conversion for quaternization.

- 20 Example A6: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-acetamidyl)]-Cl⁻ by quaternization

MA is butylacrylate and DMAEMA

MB=



R6 = -CH₂-CO-NH₂ Z is Cl⁻

- 24 -

30.6g of liquid polymer are obtained by the same quaternization condition as Example **A5** with 0.6g of 2-Chloroacetamide as quaternization agent.

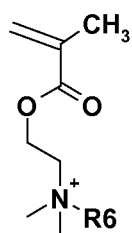
¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

5

Example **A7**: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-methoxyethoxyethyl)]-Br⁻ by quaternization

MA is butylacrylate and DMAEMA

MB=



10

R6 = -CH₂-CH₂-O-CH₂CH₂-OCH₃ Z is Br⁻

In a 100 mL flask equipped with a magnetic stirring bar and distillation column are loaded 14g of a Poly[n-BA-b-DMAEMA], 1.2g of 1-Bromo-(2-methoxyethoxy)ethane and 16 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4h.

15 After the reaction, 31.2g of liquid polymer are obtained

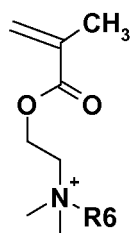
¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

Example **A8**: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-methoxyethoxymethyl)]-Cl⁻ by quaternization

20

MA is butylacrylate and DMAEMA

MB=



R6 = -CH₂-CH₂-O-CH₂CH₂-OCH₃ Z is Cl⁻

25

30.8g of liquid polymer are obtained by the same quaternization condition as Example **A7** with 0.8g of 2-Methoxyethoxymethyl chloride as quaternization agent.

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

5

Example **A9**: Synthesis of a linear block copolymer poly(n-BA-b-4VP)

In a 3-necked 500ml round bottom flask with magnetic stirring bar, cooler, thermometer 214.18 g poly(n-BA) of example **A1**, 70.9g 4-vinylpyridine (4-VP, 105.14 g/mol) and 79.70g of MPA are added, three times degassed with N₂/vacuum and polymerized at 125°C under N₂ for 8h. Residual monomers and solvents are distilled off at 80°C and 12 mbar.

10

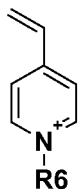
Yield 85%, GPC (THF, PS-Standard, Mn=8600 g/mol, PD=1.24), liquid.

Example **A10**: Synthesis of a block copolymer Poly[n-BA-b-(4VP-co-quaternized 4VP-butylsulfonic acid anion)] by quaternization

15

MA is Butylacrylate and vinylpyridine

MB is



20

R6= -CH₂-CH₂-CH₂-CH₂-SO₃⁻

Z is not present

In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 4.06g of a Poly[n-BA-b-4VP], 0.23g of 1,4-Butanesulfone and 6.08 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4h.

25

After the reaction, 10.4g of liquid polymer are obtained

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

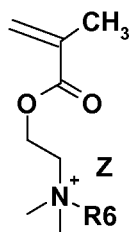
Example **A11**: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-2-acetic acid)]-Br⁻ by quaternization

30

MA is butylacrylate and DMAEMA

- 26 -

MB =

, R6 = -CH₂-COOH, Z = Br⁻

In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded
 5 10.8g of a Poly[n-BA-b-DMAEMA], 0.73g of 2-bromoacetic acid and 10.19 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4h.

After the reaction, 21.7g of liquid polymer are obtained

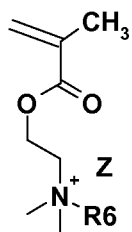
¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

10

Example A12: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-(quaternized DMAEMA-ClBn)-Cl⁻-co-(quaternized DMAEMA-butylsulfonic acid anion))] by quaternization

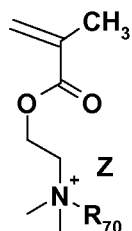
MA = BA and DMAEMA

MB =

, R6 = -CH₂-CH₂-CH₂-CH₂-SO₃⁻

15

MB' =

R70 = -o-chlorobenzyl; Z = Cl⁻

20 In a 100 mL flask equipped with a magnetic stirring bar and distillation column are loaded 10.8g of Poly[n-BA-b-DMAEMA], 0.56g of o-ClBnCl, 0.24g of 1,4-Butanesulfone and 9.2 g of 1-methoxy-2-propanol. The mixture is heated to 110°C for 4.5h.

- 27 -

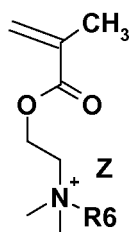
After the reaction, 20.8g of liquid polymer are obtained

$^1\text{H-NMR}$ and amine value measurement indicate quantitative conversion for quaternization.

- 5 Example A13: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-(quaternized DMAEMA-acetamidyl)-Cl⁻-co-(quaternized DMAEMA- butylsulfonic acid anion))] by quaternization

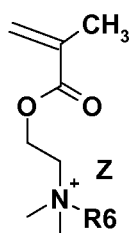
MA = BA and DMAEMA

10 MB=



, R6 = -CH₂-CO-NH₂, Z = Cl⁻

MB =



, R6 = -CH₂-CH₂-CH₂-CH₂-SO₃⁻

In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded

- 15 10.8g of Poly[n-BA-b-DMAEMA], 0.16g of 2-Chloroacetamide, 0.48g of 1,4-Butanesulfone and 9.2 g of 1-methoxy-2-propanol. The mixture is heated to 110°C for 4.5h.

After the reaction, 20.6g of liquid polymer are obtained

$^1\text{H-NMR}$ and amine value measurement indicate quantitative conversion for quaternization.

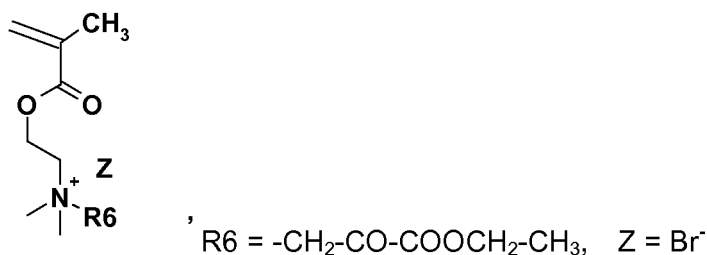
20

Example A14: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-ethylpyruvatyl)]-Br⁻ by quaternization

MA = BA and DMAEMA

MB=

- 28 -



In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 8.11g of a Poly[n-BA-b-DMAEMA], 0.77g of Ethylbromopyruvate and 6.89 g of 1-methoxy-2-

5 propanol. The mixture is heated to 95°C for 4.5h.

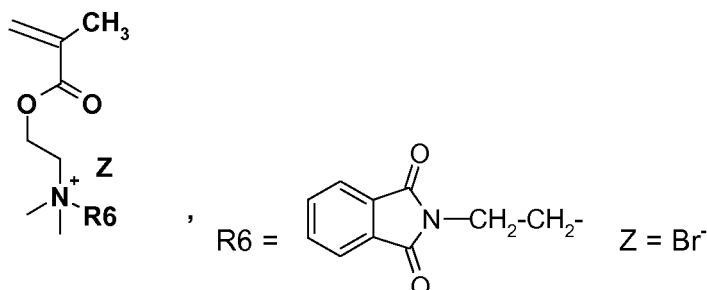
After the reaction, 15.8g of liquid polymer are obtained

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

10 Example **A15**: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-phthalimide ethyl)]-Br⁻ by quaternization

MA = BA and DMAEMA

MB is



15

In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 5.41g of a Poly[n-BA-b-DMAEMA], 0.67g of N-(2-bromoethyl)phthalimide and 4.59 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4.5h.

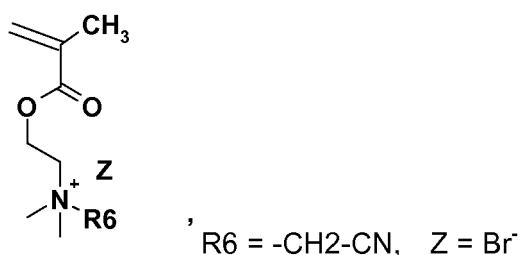
After the reaction, 10.67g of liquid polymer are obtained

20 ¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

Example A16: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-cyanomethyl)]-Br⁻ by quaternization

MA = BA and DMAEMA

5 MB=



In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 5.41g of a Poly[n-BA-b-DMAEMA], 0.31g of 1-Bromoacetonitrile and 4.59 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4h.

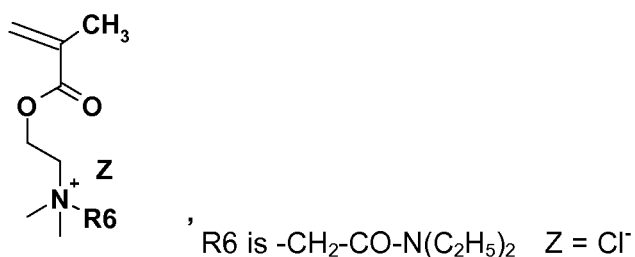
After the reaction, 10.31g of liquid polymer are obtained

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

Example A17: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-N,N-diethylacetamidyl)]-Cl⁻ by quaternization

MA = BA and DMAEMA

MB=



In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 7.85g of a Poly[n-BA-b-DMAEMA], 0.54g of 2-Chloro-N,N-diethylacetamide and 8.24 g of 1-methoxy-2-propanol. The mixture is heated to 120°C for 4.5h.

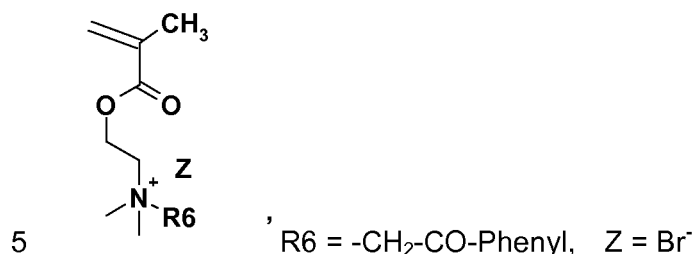
After the reaction, 16.6g of liquid polymer are obtained

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

Example A18: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-benzoylmethyl)]-Br⁻ by quaternization

MA = BA and DMAEMA

MB=



In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 10.56g of a Poly[n-BA-b-DMAEMA], 0.97g of 2-Bromoacetophenone and 9.73 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4.5h.

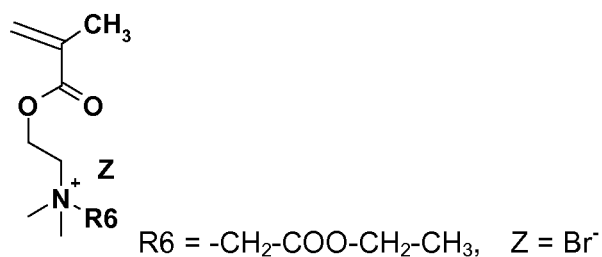
10 After the reaction, 22.26g of liquid polymer are obtained

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

Example A19: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-ethylacetate)]-Br⁻ by quaternization

15 MA = BA and DMAEMA

MB=



In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 9.40g of a Poly[n-BA-b-DMAEMA], 0.76g of 2-Bromoethylacetate and 10.6 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4.5h.

20 After the reaction, 20.76g of liquid polymer are obtained

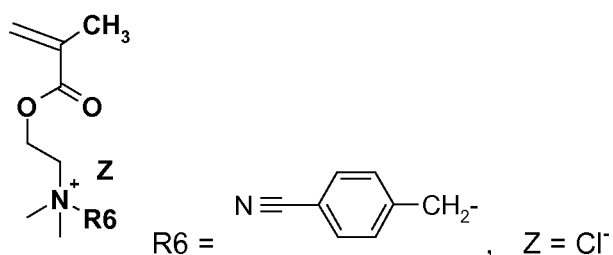
¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

Example A20: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-quaternized DMAEMA-4-cyanobenzyl)]-Cl⁻ by quaternization

MA = BA and DMAEMA

MB=

5



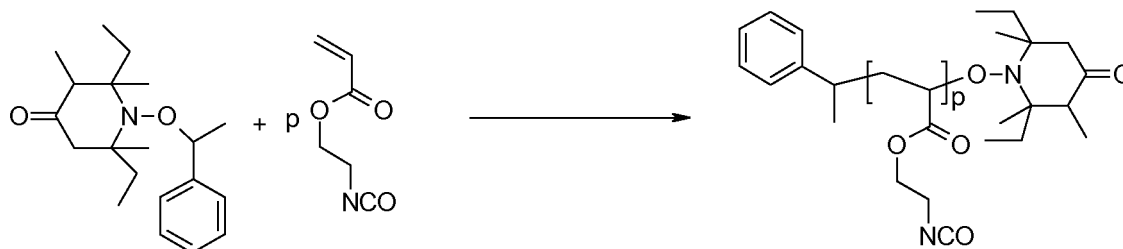
In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded 9.40g of a Poly[n-BA-b-DMAEMA], 0.69g of 4-Cyanobenzylchloride and 10.6 g of 1-methoxy-2-propanol. The mixture is heated to 95°C for 4.5h.

10

After the reaction, 20.69g of liquid polymer are obtained

¹H-NMR and amine value measurement indicate quantitative conversion for quaternization.

Example A21: Synthesis of a linear polymer poly(NCO-ethylacrylate)

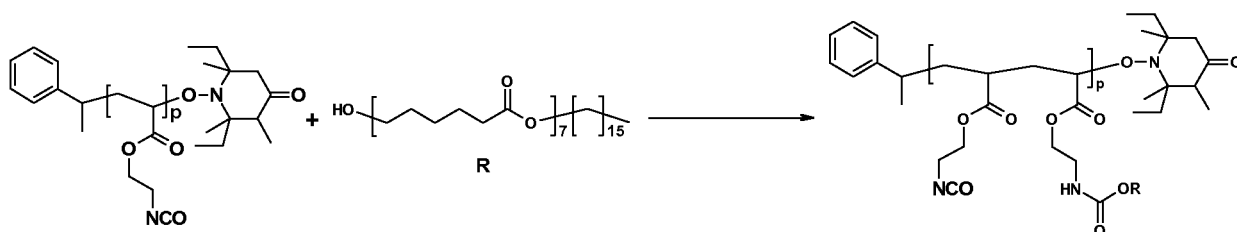


15

In a 3-necked 100ml round bottom flask with magnetic stirring bar, cooler, thermometer, dropping funnel 20.0 g of Isocyanylethylacrylate (143.19g/mol), 1.18g compound O1 (317.48g/mol) and 40g of Butylacetate were added, three times degassed with N₂/vacuum and polymerized at 135°C under N₂ until the conversion of around 48 mol%. Residual monomers and solvents were distilled off at 80°C and 12 mbar.

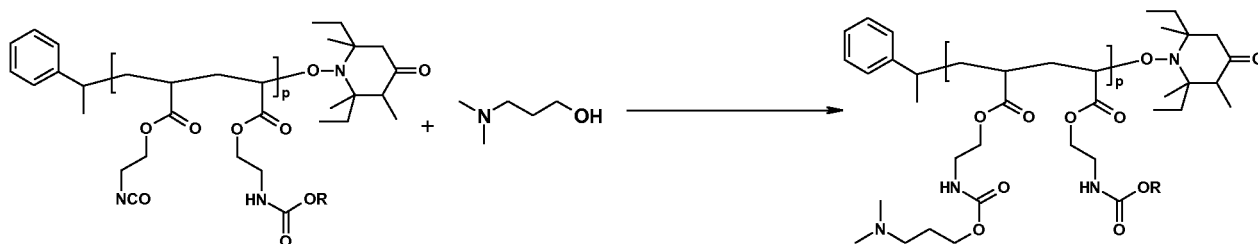
20

Yield 96%, GPC (THF, PS-Standard, Mn=4926 g/mol, PD=1.09), liquid.

Example A22: Synthesis of a comb polymer poly(NCO-ethylacrylate-co- polyesteracrylate)

- 5 In a 3-necked 100ml round bottom flask with magnetic stirring bar, cooler, thermometer, dropping funnel 10g of a polymer A21 (42.08% n-Butylacetate), 13g of polyester R and 1.26g of Triethylamine were added. The mixture was stirred at 100°C under N₂ for 3hours. After the reaction, concentration under reduced pressure afforded 20g of yellow oil.
The conversion was confirmed by ¹H-NMR spectrum.

10

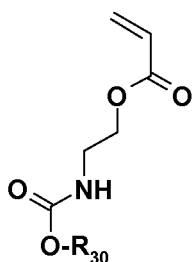
Example A23: Synthesis of a comb polymer poly(carbamateacrylate-co- polyesteracrylate)

- In a 3-necked 100ml round bottom flask with magnetic stirring bar, cooler, thermometer, dropping funnel 20g of a polymer A22, 2.58g of N,N-dimethylaminopropanol and 20g of n-
15 Butylacetate were added. The mixture was stirred at 60-90°C under N₂ for 3hours.
After the reaction, concentration under reduced pressure afforded 17.61g of yellow solid.
The conversion was confirmed by ¹H-NMR spectrum.

Example A24: Synthesis of a comb polymer poly(carbamateacrylate-co- polyesteracrylate-co-quaternized carbamateacrylate -butylsulfonic acid anion))] by quaternization)

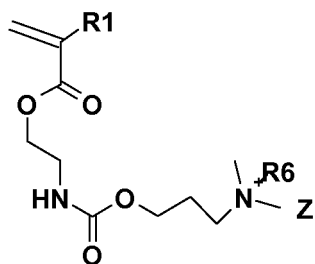
20

MA is



- 33 -

MB is

R6 = $-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{SO}_3^-$

In a 50 mL flask equipped with a magnetic stirring bar and distillation column are loaded
 5 7.42g of A23, 0.19g of 1,4-Butanesulfone and 7.58 g of 1-methoxy-2-propanol. The mixture
 is heated to 95°C for 6h.

After the reaction, 15.19g of liquid polymer are obtained

$^1\text{H-NMR}$ and amine value measurement indicate quantitative conversion for quaternization.

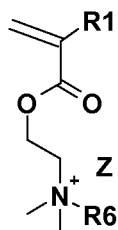
- 10 Example A25: Synthesis of a block copolymer Poly[n-BA-b-(DMAEMA-co-(quaternized
 DMAEMA--acetamide)-Cl⁻-co-(quaternized DMAEMA- polyoxyalkylenealkylether polybasic
 acid))] by quaternization

In a 25 mL flask equipped with a magnetic stirring bar and distillation column are loaded 1.2g
 of Poly[n-BA-b-DMAEMA], 0.5g of 2-Chloroacetamidel, 0.35 of polyoxyalkylenealkylether
 15 polybasic acid and 2 g of 1-methoxy-2-propanol. The mixture is heated to 110°C for 4.5h.
 After the reaction, 4.05g of liquid polymer are obtained.

$^1\text{H-NMR}$ and amine value measurement indicate quantitative conversion for quaternization.

MA = BA and DMAEMA

MB =



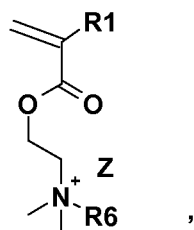
, R6 = $-\text{CH}_2-\text{CO}-\text{NH}_2$, Z = Cl^-

20

25

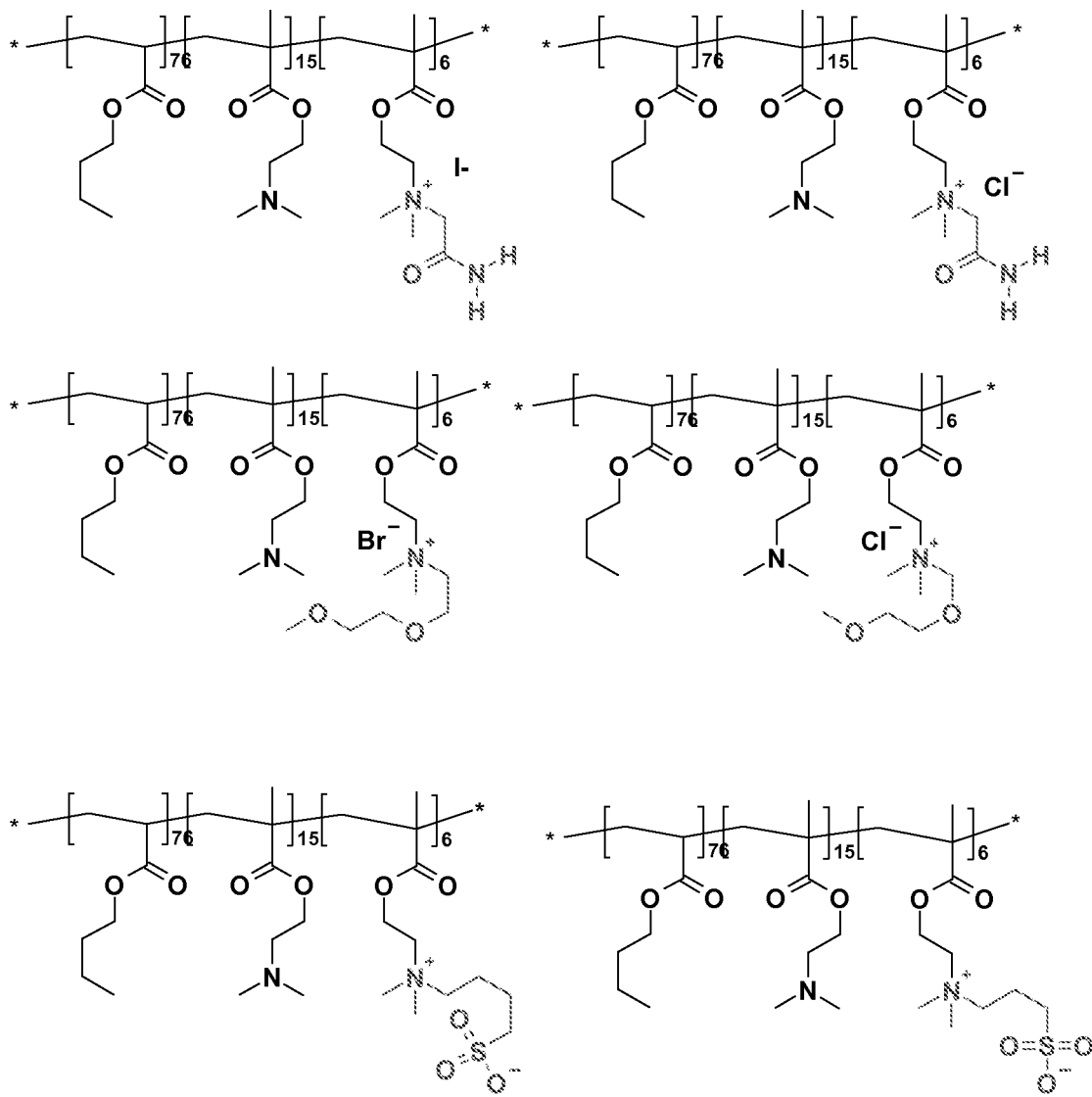
- 34 -

MB=

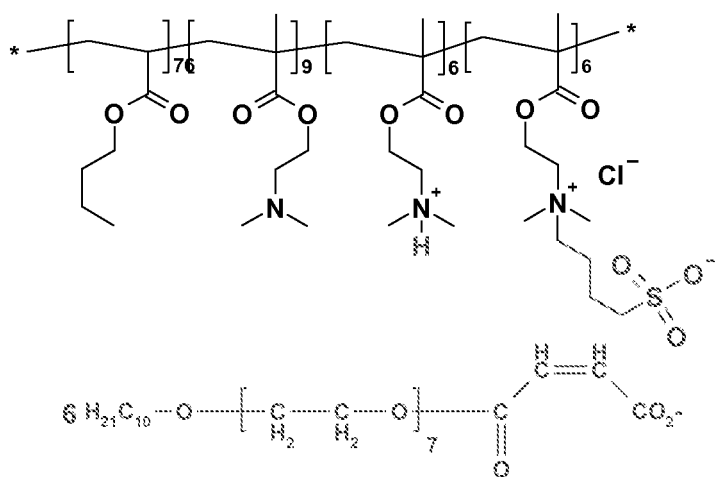
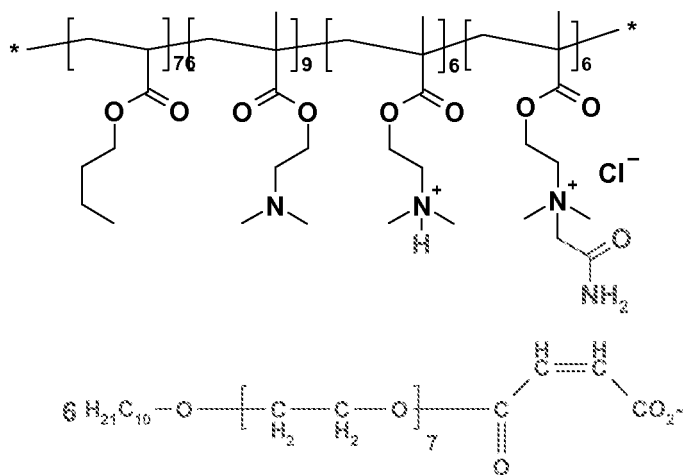


5 R₆ = polyoxyalkylenealkylether Z = polybasic acid

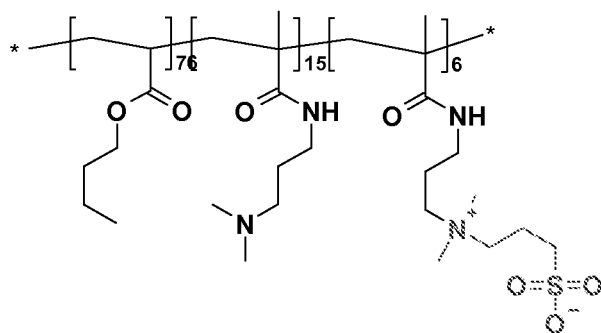
Suitable structure of new salt modified dispersants are



- 36 -

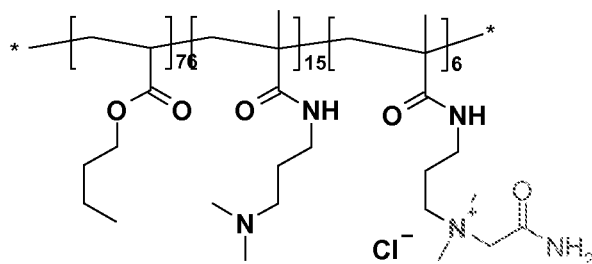
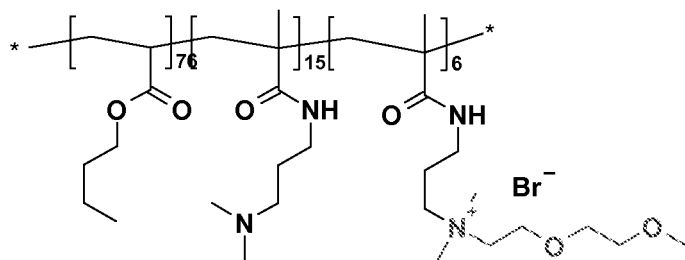


5

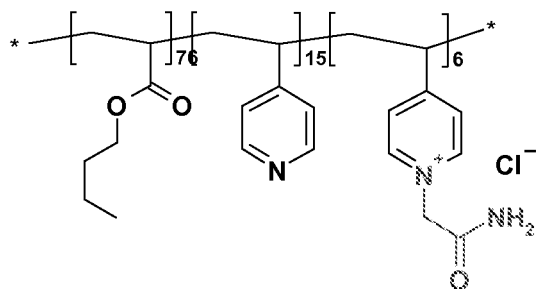
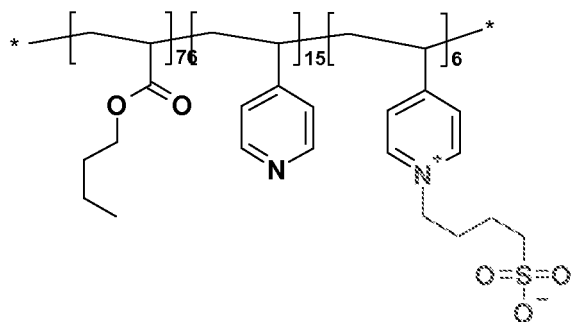


10

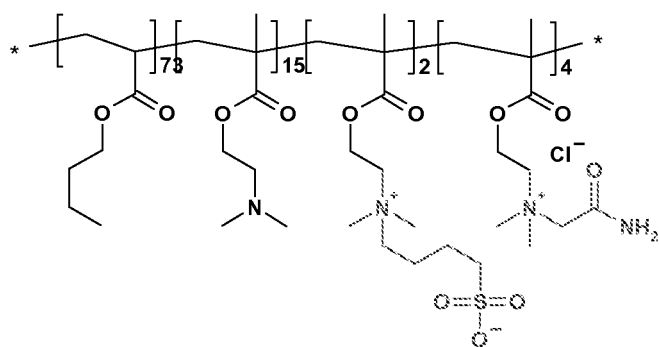
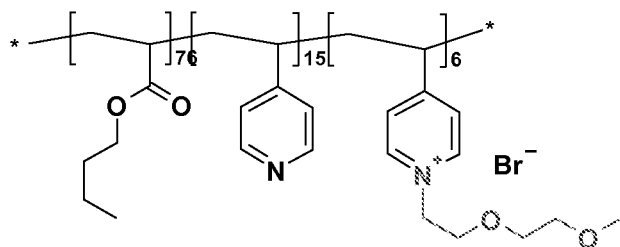
- 37 -



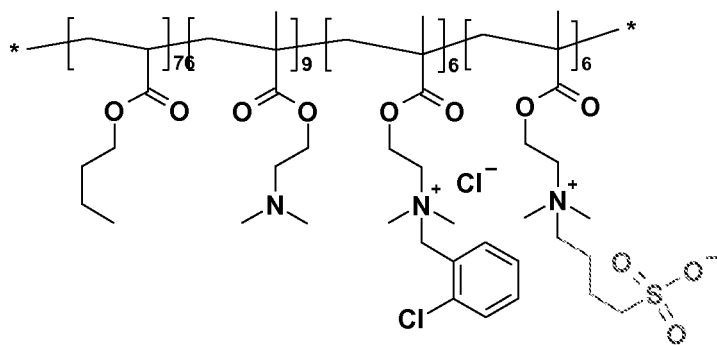
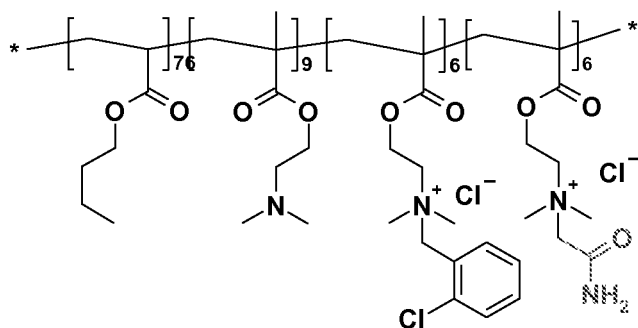
5



- 38 -

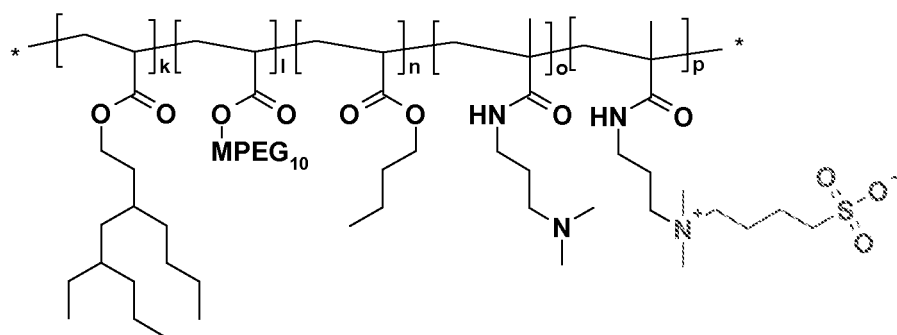
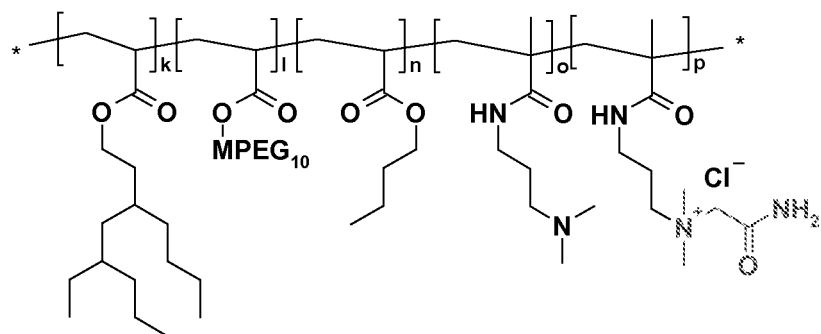
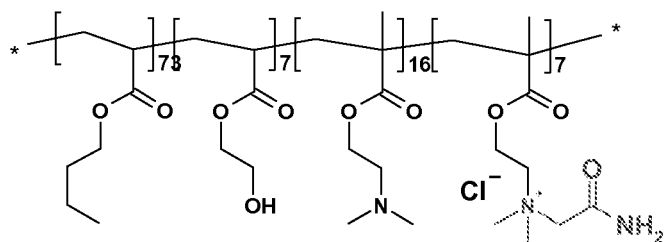


5

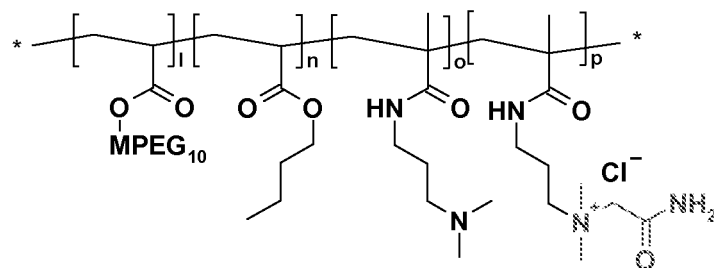


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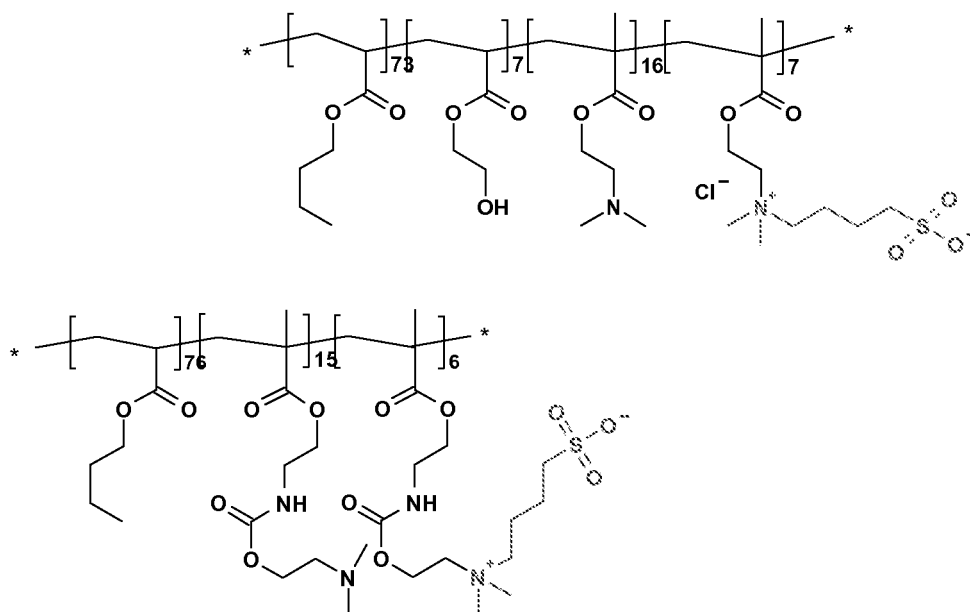
- 39 -



5



- 40 -



Preparation of Poly(benzylmethacrylate-co-methacrylic acid) – binder:

24 g of benzyl-methacrylate, 6 g of methacrylic acid and 0.525 g of azobisisobutyronitrile (AIBN) are dissolved in 90 ml of propylene glycol 1-monomethyl ether 2-acetate (PGMEA).

- 5 The resulting reaction mixture is placed in a preheated oil bath at 80°C. After stirring for 5 hours at 80°C under nitrogen, the resulting viscous solution is cooled to room temperature and used without further purification. The solid content is about 25%.

Preparation of dispersion films for color filter:

10

The following substances are placed into a 37 ml screw bottle:

for PB15:6 system

1.0 g	PB15:6
7.0 g	propylene glycol 1-monomethyl ether 2-acetate
0.4 g	dispersant (solid)
4.0 g	binder (25wt% in PGMEA as mentioned above)
0.08 g	Solsperse 5000 (Lubrizol)
50.0 g	zircon beads

Standard CF grade pigments used for the examples:

- 15 C.I. Pigment Blue 15:6 : average of major axis 49nm, minor axis 26nm from TEM picture

Standard high molecular weight dispersants used for the examples:

Ciba EFKA-4046 : Ciba SC

- 20 Disperbyk 2000, 2001 : Altana - BYK Chemie

The bottle is sealed with an inner cup and then applied to a paint conditioner for 3 hours to give the final dispersion. The dispersion thus obtained is cast onto a glass substrate by means of a spin coating, wherein a layer thickness is adjusted to give a film having a desired color points (by standard C light, observation 2 degree) by controlling rotation speed, then dried at 60 °C for 1 hour.

25

Optical properties of the dispersion films thus obtained are measured by use of a spectrophotometer (UV-2550PC, Shimadzu) and contrast measurement equipment (Model CT-1, Tsubosaka Electric Co., Ltd). The color points (C.I.E.1931 x, y chromaticity diagram) are calculated using standard C light.

5

Viscosity measurements are performed by using a Brookfield Rheometer (Model DV-III ULTRA) with a cone/plate set-up at 25 °C.

10 Developability of the dispersion films are measured by immersing into alkaline developer (Semi Clean DL-A4, Yokohama Oil & Fats Industry Co., LTD / water = 10 / 90 vol%). Classify developability to 3 types. Dissolve, Dissolve then peel, Peel. Dissolve type is suitable for color filter application.

Measured immersing time until films completely disappeared from glass substance. In this

15 formulation, 10-30 minutes indicated suitable level for color filter application.

Table 1: Performance data for a pigment system PB 15:6

sample details		initial viscosity [mPa s]		1week viscosity [mPa s]		color property (y=0.60)		
dispersant	solids [%]	6 rpm	60 rpm	6 rpm	60 rpm	x	Y	contrast
BYK 2000	40	30	27	19	18	0.136	16.8	4700
BYK 2001	46	14	13	12	12	0.136	17.1	4700
EFGA 4046	40	16	16	25	23	0.136	17.2	4630
A3	47	15	14	14	13	0.136	16.9	4600
A4	51	21	20	20	18	0.136	17.2	4960
A5	49	15	14	14	13	0.136	17.2	5140
A6	50	15	14	13	13	0.136	17.2	5120
A7	50	14	14	13	13	0.136	17.1	5020
A8	45	15	15	14	14	0.136	17.1	5060
A10	51	12	12	12	11	0.136	17.1	5310
A12	50	14	13	12	12	0.136	17.2	5090
A13	53	17	16	16	16	0.136	17.4	5200
A14	48	13	14	13	13	0.136	17.1	5390
A15	47	13	13	12	11	0.136	17.2	5320

Table 2: Developability data for a pigment system PB 15:6

sample details		developability	
dispersant	solids [%]	type	time [min]
BYK 2000	40	Peel	360
BYK 2001	46	Dissolve then peel	120
EFKA 4046	40	Dissolve then peel	60
A3	53	Dissolve then peel	60
A4	51	Dissolve only	20
A5	49	Dissolve only	60
A6	50	Dissolve only	60
A7	50	Dissolve only	30
A8	45	Dissolve then peel	30
A10	51	Dissolve only	30
A12	50	Dissolve only	40
A13	53	Dissolve only	30
A14	48	Dissolve only	30
A15	47	Dissolve only	20

In this example, A4 -A8, A10, A12-A15 related to this invention are compared to A3. Beside a good viscosity stability we see high Y value and high contrast ratio, which is an indication for an improved dispersion containing primary particles only. A complete de-agglomeration is achieved.

In addition, A4-A7, A10-A15, had the most suitable developability type 'Dissolve type' for color filter application. And also A4, A7, A8, A10, A13-A15 showed suitable development time.

Claims

1. A copolymer made by controlled polymerisation or by conventional polymerization comprising

5 **at least one monomer (MA_r)** selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers,

at least one monomer (MB_s) selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers wherein the monomer **MB** has a quaternized **N-atom** structure with a **polar substituent** selected from
 10 polyether, polyamine, nitrile, amide, imine, imide, ester, ketone, nitrile, aldehyde, diketone, ketoester, ketoamide, carbonate, carbamate, carbamide, sulfoxide, sulfone, carboxylic acid, sulfonic acid, phosphoric acid groups; or carboxylic acid anion, sulfonic acid anion or phosphoric acid anion groups which is formed as betaine structure

r denotes the total number of monomers MA within the structural element (MA_r) and r is
 15 > 5 , preferred 10-1000, most preferred 10-500;

s denotes the total number of monomers MB within the structural element (MB_s) and s is > 1 , preferred 2-100, most preferred 2-50.

20 2. A copolymer according to claim 1, wherein **MA-monomers** are selected from CH₂=CH-C(O)OR₂, CH₂=C(CH₃)-C(O)OR₂, CH₂=C(R₁)-C(O)OR₂ CH₂=CH-C(O)NR₄R₅, CH₂=C(CH₃)-C(O)NR₄R₅ CH₂=C(R₁)-C(O)NR₄R₅ or CH₂=C(R₁₀)-Ar, wherein

R_1 is halogen or cyano or R_1 is C₁-C₁₈alkyl, C₂-C₁₈alkenyl, C₃-C₁₈cycloalkyl, C₄-C₁₈cycloalkenyl, C₆-C₂₄aryl, C₁-C₁₂alkyl-C₆-C₂₄aryl or C₂-C₁₂alkenyl-C₆-C₂₄aryl each of
 25 which optionally is substituted by one or more halogen or OR₃, SR₃ or NR₄R₅; and/or optionally is interrupted by one or more -O-, -S-, -NR₄-,

R_2 is hydrogen; or R_2 is C₁-C₄₀alkyl, C₂-C₄₀alkenyl, C₃-C₄₀cycloalkyl, C₄-C₄₀cycloalkenyl, C₆-C₂₄aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen, OR₃, SR₃, NR₄R₅, NH-CO-OR₂₀ with R_{20}
 30 is -C₂-C₆alkylene-NR₄R₅ or is a polyester residue and/or optionally is interrupted by one or more -O-, -S-, -NR₄-, -C(O)-, -C(O)O-, -C(O)NR₄- or -OC(O)NR₄-

R_3 is hydrogen; or R_3 is C₁-C₂₀alkyl, C₂-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₂₄aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen, OC₁-C₁₂alkyl, SC₁-C₁₂alkyl or NR₄R₅; and/or

each of which is optionally interrupted by one or more $-O-$, $-C(O)-$, $-C(O)O-$, $-S-$, $-NR_4-$,

R_4, R_5 independently of each other are hydrogen; or R_4, R_5 independently of each other are C_1-C_{20} alkyl, C_2-C_{20} alkenyl, C_3-C_{20} cycloalkyl, C_4-C_{20} cycloalkenyl, C_6-C_{18} aryl, C_1-C_{20} alkyl- C_6-C_{24} aryl or C_2-C_{20} alkenyl- C_6-C_{24} aryl each of which optionally is substituted by one or more halogen, OR_3 , SR_3 , $C(O)R_3$, $N(C_1-C_{12}alkyl)_2$; and/or optionally is interrupted by one or more $-O-$, $-S-$, $-C(O)-$ or $-NC_1-C_{12}alkyl$; R_4 and R_5 can optionally form 5-, 6- or 7-membered rings with each other;

R_{10} is hydrogen, halogen or cyano; or R_{10} is C_1-C_{18} alkyl, C_2-C_{18} alkenyl, C_3-C_{18} cycloalkyl, C_4-C_{18} cycloalkenyl, C_6-C_{24} aryl, C_1-C_{12} alkyl- C_6-C_{24} aryl or C_2-C_{12} alkenyl- C_6-C_{24} aryl each of which optionally is substituted by one or more halogen or OR_3 , SR_3 or NR_4R_5 ; and/or optionally is interrupted by one or more $-O-$, $-S-$, $-NR_4-$,

Ar is pyridyl or imidazolyl, or C_6-C_{24} aryl which optionally is substituted by one or more halogen, C_1-C_{20} alkyl, C_2-C_{20} alkenyl, OR_3 , SR_3 , NR_4R_5 , $C(O)R_3$, $C(O)OR_3$, $C(O)SR_3$ or $C(O)N R_4R_5$.

3. A copolymer according to claim 1, wherein **MA-monomers** are selected from $CH_2=CH-C(O)OR_2$, $CH_2=C(CH_3)-C(O)OR_2$, $CH_2=CH-C(O)NR_4R_5$, $CH_2=C(CH_3)-C(O)NR_4R_5$ or $CH_2=CH-Ar$ wherein R_2 , R_4 , R_5 and Ar are as defined in claim 2.

4. A copolymer according to claim 3, wherein R_2 is linear or branched C_1-C_{40} alkyl, or C_1-C_{40} alkyl substituted by one or more halogen, OH , $-N(C_1-C_{20}alkyl)_2$, $-NH-CO-O-C_2-C_6$ alkylene- $N(C_1-C_{20}alkyl)_2$, $-NH-CO-O-C_1-C_{40}alkylene$ interrupted by one or more $-O-$. and Ar is phenyl, tolueneyl, pyridyl, imidazolyl.

5. A copolymer according to claim 1, wherein the monomer **MB** has the general formula $CH_2=C(R_{11})-W-Y-Z$ wherein

R_{11} is hydrogen, halogen or cyano; or R_1 is C_1-C_{18} alkyl, C_2-C_{18} alkenyl, C_3-C_{18} cycloalkyl, C_4-C_{18} cycloalkenyl, C_6-C_{24} aryl, C_1-C_{12} alkyl- C_6-C_{24} aryl or C_2-C_{12} alkenyl- C_6-C_{24} aryl each of which optionally is substituted by one or more halogen or OR_3 , SR_3 or NR_4R_5 ; and/or optionally is interrupted by one or more $-O-$, $-S-$, $-NR_4-$;

R₃ is hydrogen; or **R₃** is C₁-C₂₀alkyl, C₂-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₂₄aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen, OC₁-C₁₂alkyl, SC₁-C₁₂alkyl or **NR₄R₅**; and/or each of which is optionally interrupted by one or more -O-, -C(O)-, -C(O)O-, -S-,
5 , -**NR₄**-

R₄, R₅ independently of each other are hydrogen; or **R₄, R₅** independently of each other are C₁-C₂₀alkyl, C₂-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₁₈aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which optionally is substituted by one or more halogen, OR₃, SR₃, C(O)R₃, N(C₁-C₁₂alkyl)₂; and/or optionally is interrupted by one or more -O-, -S-, -C(O)- or -NC₁-C₁₂alkyl-I; **R₄** and **R₅**
10 can be optionally form 5-, 6- or 7-membered rings with each other and/or **R₃** or **R₆**

W is direct bond or C(O)-X; or **W** is C₁-C₁₆alkylene, C₁-C₁₆alkenylene, C₆-C₁₈arylene, each of which optionally is interrupted by one or more -O-, -S-, -**NR₄**-,

X is OC₁-C₁₆alkylene, OC₁-C₁₆alkenylene, -OC₁-C₁₆alkylene-NH-CO-OC₁-
15 C₁₆alkylene -SC₁-C₁₆alkylene, -SC₁-C₁₆alkenylene, -**NR₄**C₁-C₁₆alkylene, -**NR₄**C₁-C₁₆alkenylene, -OC₆-C₁₈arylene, -SC₆-C₁₈arylene, -**NR₄**C₆-C₁₈arylene each of which optionally is interrupted by one or more -O-, -S-, -**NR₄**-, -**NR₄**C(O)O-, -**NR₄**C(O)S- or -**NR₄**C(O) **NR₄**-

Y is C₂-C₂₄cyclicammonium⁺-**R₆** or N⁺**R₄R₅R₆**

R₆ is C₁-C₂₀alkyl, C₁-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₁₈aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which is **substituted** one or more than once by CN, O[C₂-C₈alkyleneO]_m**R₃**, S[C₂-C₈alkyleneO]_m**R₃**, O[C₂-C₈alkyleneS]_m**R₃**, O[C₂-C₈alkyleneN]_m**R₄R₅**, **NR₄R₅**[C₂-C₈alkyleneN]_m**R₄R₅**, C(O)**R₃**, C(O)OR₃, C(O)SR₃, C(O)**NR₄R₅**, S(O)**R₃**, S(O)₂**R₃**, S(O)₂OR₃, S(O)₂**NR₄R₅**,
25 OS(O)₂**R₃**, OS(O)₂OR₃, P(O)(OR₃)₂, OP(O)(OR₃)₂, OC(O)**R₃**, OC(O)OR₃, OC(O)SR₃, OC(O)**NR₄R₅**, SC(O)OR₃, SC(O)SR₃, SC(O)**NR₄R₅**, **NR₄**C(O)**R₃**, **NR₄**C(O)OR₃, **NR₄**C(O)SR₃, **NR₄**C(O)**NR₄R₅**, C(O)C(O)**R₃**, C(O)C(O)OR₃, C(O)C(O)SR₃, C(O)C(O)**NR₄R₅**, C(O)O⁻, S(O)₂O⁻ or P(O)OR₃O⁻, **provided that**

if **R₆** is C₁-C₂₀alkyl, C₁-C₂₀alkenyl, C₃-C₂₀cycloalkyl, C₄-C₂₀cycloalkenyl, C₆-C₁₈aryl, C₁-C₂₀alkyl-C₆-C₂₄aryl or C₂-C₂₀alkenyl-C₆-C₂₄aryl each of which is substituted by one or more C(O)O⁻, S(O)₂O⁻ or P(O)OR₃O⁻, **Z** is not existing.

Z is PF₆⁻, BF₄⁻, OH⁻, F⁻, Cl⁻, Br⁻ or I⁻; or **Z** is C₁-C₄₀alkyl[C(O)O⁻]_n, C₁-C₄₀alkenyl[C(O)O⁻]_n, C₃-C₄₀cycloalkylC(O)O⁻, C₄-C₄₀cycloalkenylC(O)O⁻, C₆-C₂₄aryl[C(O)O⁻]_n, C₁-C₄₀alkyl[S(O)₂O⁻]_n, C₁-C₄₀alkenyl[S(O)₂O⁻]_n, C₃-C₄₀cycloalkylS(O)₂O⁻,

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C₄-C₄₀cycloalkenylS(O)₂O⁻, C₆-C₂₄aryl[S(O)₂O⁻]_n, C₁-C₄₀alkyl[P(O)OR₃O⁻]_n,
 C₁-C₄₀alkenyl[P(O)OR₃O⁻]_n, C₃-C₄₀cycloalkylP(O)OR₃O⁻, C₃-C₄₀cycloalkenylP(O)OR₃O⁻
 or C₆-C₂₄aryl[P(O)OR₃O⁻]_n each of which optionally is interrupted by one or more -O-,
 -S-, -NR₄-, -C(O)-, -C(O)O-, -C(O)S-, -C(O)NR₄-, -OC(O)O-, -SC(O)O-, -SC(O)S-, -
 5 SC(O)NR₄-, -OC(O)NR₄- or -NR₄C(O)NR₄-;

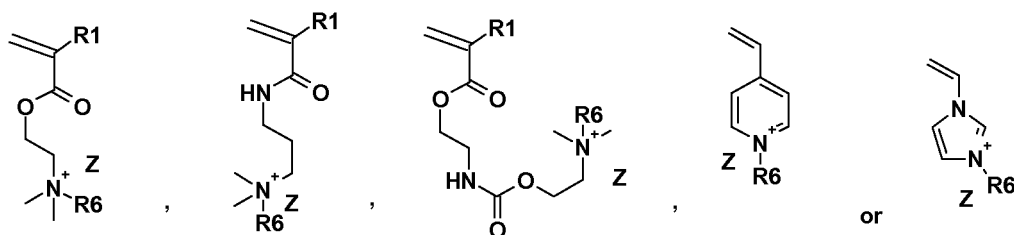
m is >1, preferred 1-120, most preferred 1-40,

n is >1, preferred 1-5, most preferred 1-2

- 10 **6.** A copolymer according to claim 1, wherein the monomer **MB** has the general formula
 CH₂=CH-**W**-**YZ** or CH₂=C(CH₃)-**W**-**YZ** wherein W is a direct bond or C(O)X and X is -OC₁-
 C₁₆alkylene or -OC₁-C₁₆alkylene-NH-CO-OC₁-C₁₆alkylene or is -NHC₁-C₁₆alkylene and Y and
 Z are as defined in claim 5.

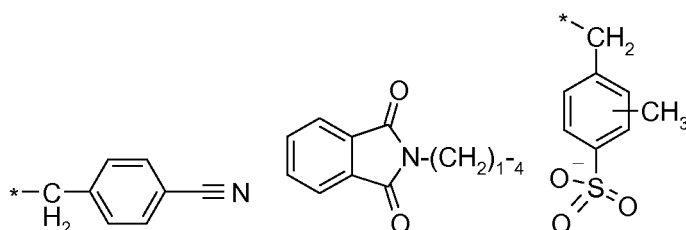
15

- 7.** A copolymer according to claim 1 wherein the monomer **MB** is selected from



wherein R₁ is hydrogen or methyl and

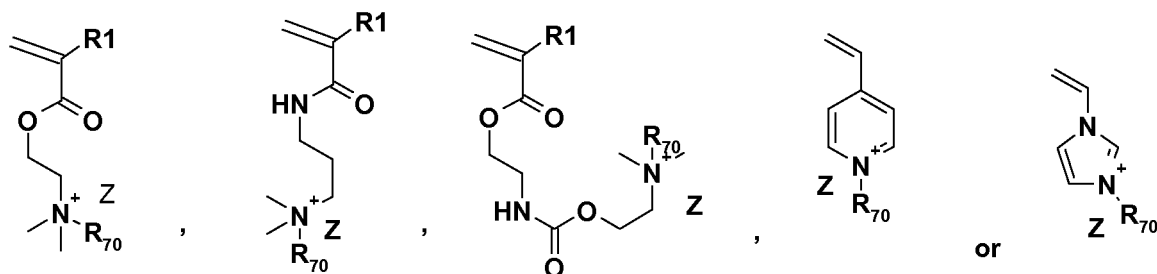
- R₆** is --(CH₂)₁₋₁₈CN, -(CH₂)₁₋₁₈SO₃⁻, -(CH₂)₁₋₁₈C(O)O⁻, -CH₂-O[C₂-C₈alkyleneO]_mH, -
 20 CH₂C(O)CH₃, -CH₂CHO, -CH₂C(O)OC₁-C₁₈alkyl, -CH₂C(O)OH, -CH₂C(O)NH₂, -
 CH₂C(O)N(C₁-C₁₈alkyl)₂, -CH₂C(O)C(O)OC₁-C₁₈alkyl, -CH₂C(O)CH₂C(O)OC₁-
 C₁₈alkyl, -CH₂CH₂NHC(O)NH₂, or



- Z** is Cl⁻, Br⁻ or I⁻; or **Z** is C₁-C₄₀alkylC(O)O⁻, C₁-C₄₀alkenylC(O)O⁻, C₆-C₁₀arylC(O)O⁻, C₁-
 25 C₄₀alkylS(O)₂O⁻, C₁-C₄₀alkenylS(O)₂O⁻, C₆-C₁₀arylS(O)₂O⁻, C₁-C₄₀alkylP(O)OR₃O⁻ each of
 which optionally is interrupted by one or more -O-.

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8. A copolymer MA_r-MB_s according to claim 1 which comprises further monomers MB'_s of the general formula



5 wherein R_1 is hydrogen or methyl and

R_{70} is hydrogen, benzyl, o-chlorobenzyl, o,p-chlorobenzyl, 1-naphtyl, C_1 - C_4 alkyl, C_1 - C_4 alkenyl

Z is Cl^- , Br^- or I^- ; or Z is C_1 - C_{40} alkyl $C(O)O^-$, C_1 - C_{40} alkenyl $C(O)O^-$, C_6 - C_{10} aryl $C(O)O^-$, C_1 - C_{40} alkyl $S(O)_2O^-$, C_1 - C_{40} alkenyl $S(O)_2O^-$, C_6 - C_{10} aryl $S(O)_2O^-$, C_1 - C_{40} alkyl $P(O)OR_3O^-$ each of which optionally is interrupted by one or more $-O-$.

10

9. A copolymer according to the claim 1 made by controlled polymerization.

15 10. A copolymer according to the claim 1 made by nitroxide mediated controlled polymerization and having the general formula



wherein

In is an initiator fragment capable to initiate radical polymerisation,

20 **E** is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the polymer or copolymer; or a group which results from a substitution or elimination reaction of the attached stable free nitroxyl radical.

$z = \geq 1$

$t = 1$ to 20.

25

11. A pigment dispersion in organic solvent dispersed by means of a copolymer of claim 1-10.

12. A coating composition comprising:

- a) film forming binder,
- b) pigment,
- 5 c) optionally other conventional coating components and/or additives,
- d) dispersant which is copolymer of claim 1-10.

13. A color filter composition comprising

- 10 a) photo resist binder,
- b) transparent pigment,
- c) optionally a solvent and/or optionally a photoinitiator or a photolatent catalyst,
- d) dispersant which is copolymer of claim 1-10.

15

14. The use of a copolymer according to claim 1- 10 to prepare paints, printing inks, inkjet inks, color resists and inkjet inks for color filters.

AMENDED CLAIMS

received by the International Bureau on 20 November 2009 (20.11.2009)

Claims

1. A copolymer made by nitroxide mediated controlled polymerisation comprising,
 at least one monomer (**MA_r**) selected from unsaturated monomers out of the group of
 5 acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers,

at least one monomer (**MB_s**) selected from unsaturated monomers out of the group of
 acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers wherein the
 monomer **MB** has a quaternized **N-atom** structure with a **polar substituent** selected from
 polyether, polyamine, nitrile, amide, imine, imide, ester, ketone, nitrile, aldehyde, diketone,
 10 ketoester, ketoamide, carbonate, carbamate, carbamide, sulfoxide, sulfone, carboxylic acid,
 sulfonic acid, phosphoric acid groups; or carboxylic acid anion, sulfonic acid anion or
 phosphoric acid anion groups which is formed as betaine structure

r denotes the total number of monomers **MA** within the structural element (**MA_r**) and **r** is
 > 5, preferred 10-1000, most preferred 10-500;

15 **s** denotes the total number of monomers **MB** within the structural element (**MB_s**) and **s** is
 > 1, preferred 2-100, most preferred 2-50,

a fragment **In** of an initiator **In-E** capable to initiate radical polymerisation, and

a group **E** bearing at least one stable free nitroxyl radical which is bound via the oxygen
 atom to the copolymer.

20 2. A copolymer according to claim 1, wherein **MA-monomers** are selected from
 $\text{CH}_2=\text{CH}-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{C}(\text{CH}_3)-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{C}(\text{R}_1)-\text{C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{CH}-\text{C}(\text{O})\text{NR}_4\text{R}_5$,
 $\text{CH}_2=\text{C}(\text{CH}_3)-\text{C}(\text{O})\text{NR}_4\text{R}_5$, $\text{CH}_2=\text{C}(\text{R}_1)-\text{C}(\text{O})\text{NR}_4\text{R}_5$ or $\text{CH}_2=\text{C}(\text{R}_{10})-\text{Ar}$, wherein

25 **R₁** is halogen or cyano or **R₁** is **C₁-C₁₈alkyl**, **C₂-C₁₈alkenyl**, **C₃-C₁₈cycloalkyl**, **C₄-C₁₈cycloalkenyl**, **C₆-C₂₄aryl**, **C₁-C₁₂alkyl-C₆-C₂₄aryl** or **C₂-C₁₂alkenyl-C₆-C₂₄aryl** each of
 which optionally is substituted by one or more halogen or **OR₃**, **SR₃** or **NR₄R₅**; and/or
 optionally is interrupted by one or more **-O-**, **-S-**, **-NR₄-**,

30 **R₂** is hydrogen; or **R₂** is **C₁-C₄₀alkyl**, **C₂-C₄₀alkenyl**, **C₃-C₄₀cycloalkyl**, **C₄-C₄₀cycloalkenyl**,
C₆-C₂₄aryl, **C₁-C₂₀alkyl-C₆-C₂₄aryl** or **C₂-C₂₀alkenyl-C₆-C₂₄aryl** each of which optionally
 is substituted by one or more halogen, **OR₃**, **SR₃**, **NR₄R₅**, **NH-CO-OR₂₀** with **R₂₀**
 is **-C₂-C₆alkylene-NR₄R₅** or is a polyester residue and/or optionally is interrupted by
 one or more **-O-**, **-S-**, **-NR₄-**, **-C(O)-**, **-C(O)O-**, **-C(O)NR₄-** or **-OC(O)NR₄-**

R₃ is hydrogen; or **R₃** is **C₁-C₂₀alkyl**, **C₂-C₂₀alkenyl**, **C₃-C₂₀cycloalkyl**, **C₄-C₂₀cycloalkenyl**,
C₆-C₂₄aryl, **C₁-C₂₀alkyl-C₆-C₂₄aryl** or **C₂-C₂₀alkenyl-C₆-C₂₄aryl** each of which optionally

is substituted by one or more halogen, $\text{OC}_1\text{-C}_{12}\text{alkyl}$, $\text{SC}_1\text{-C}_{12}\text{alkyl}$ or NR_4R_5 ; and/or each of which is optionally interrupted by one or more $-\text{O}-$, $-\text{C}(\text{O})-$, $-\text{C}(\text{O})\text{O}-$, $-\text{S}-$, $-\text{NR}_4-$,

R_4 , R_5 independently of each other are hydrogen; or R_4 , R_5 independently of each other are $\text{C}_1\text{-C}_{20}\text{alkyl}$, $\text{C}_2\text{-C}_{20}\text{alkenyl}$, $\text{C}_3\text{-C}_{20}\text{cycloalkyl}$, $\text{C}_4\text{-C}_{20}\text{cycloalkenyl}$, $\text{C}_6\text{-C}_{18}\text{aryl}$, $\text{C}_1\text{-C}_{20}\text{alkyl-C}_6\text{-C}_{24}\text{aryl}$ or $\text{C}_2\text{-C}_{20}\text{alkenyl-C}_6\text{-C}_{24}\text{aryl}$ each of which optionally is substituted by one or more halogen, OR_3 , SR_3 , $\text{C}(\text{O})\text{R}_3$, $\text{N}(\text{C}_1\text{-C}_{12}\text{alkyl})_2$; and/or optionally is interrupted by one or more $-\text{O}-$, $-\text{S}-$, $-\text{C}(\text{O})-$ or $-\text{NC}_1\text{-C}_{12}\text{alkyl}$; R_4 and R_5 can optionally form 5-, 6- or 7-membered rings with each other;

R_{10} is hydrogen, halogen or cyano; or R_{10} is $\text{C}_1\text{-C}_{18}\text{alkyl}$, $\text{C}_2\text{-C}_{18}\text{alkenyl}$, $\text{C}_3\text{-C}_{18}\text{cycloalkyl}$, $\text{C}_4\text{-C}_{18}\text{cycloalkenyl}$, $\text{C}_6\text{-C}_{24}\text{aryl}$, $\text{C}_1\text{-C}_{12}\text{alkyl-C}_6\text{-C}_{24}\text{aryl}$ or $\text{C}_2\text{-C}_{12}\text{alkenyl-C}_6\text{-C}_{24}\text{aryl}$ each of which optionally is substituted by one or more halogen or OR_3 , SR_3 or NR_4R_5 ; and/or optionally is interrupted by one or more $-\text{O}-$, $-\text{S}-$, $-\text{NR}_4-$,

Ar is pyridyl or imidazolyl, or $\text{C}_6\text{-C}_{24}\text{aryl}$ which optionally is substituted by one or more halogen, $\text{C}_1\text{-C}_{20}\text{alkyl}$, $\text{C}_2\text{-C}_{20}\text{alkenyl}$, OR_3 , SR_3 , NR_4R_5 , $\text{C}(\text{O})\text{R}_3$, $\text{C}(\text{O})\text{OR}_3$, $\text{C}(\text{O})\text{SR}_3$ or $\text{C}(\text{O})\text{N R}_4\text{R}_5$.

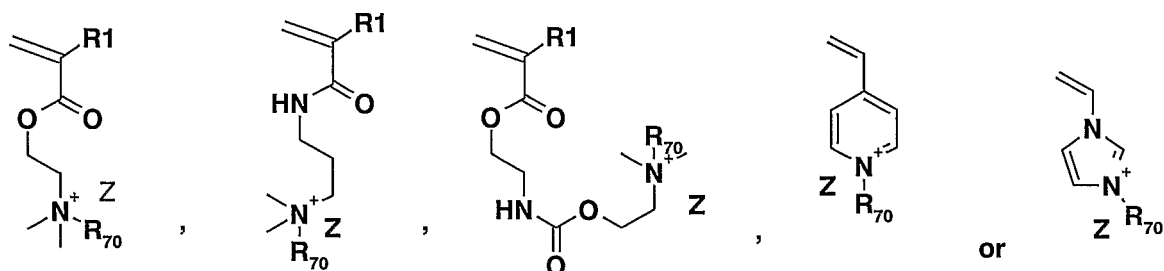
3. A copolymer according to claim 1, wherein **MA-monomers** are selected from $\text{CH}_2=\text{CH-C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{C}(\text{CH}_3)\text{-C}(\text{O})\text{OR}_2$, $\text{CH}_2=\text{CH-C}(\text{O})\text{NR}_4\text{R}_5$, $\text{CH}_2=\text{C}(\text{CH}_3)\text{-C}(\text{O})\text{NR}_4\text{R}_5$ or $\text{CH}_2=\text{CH-Ar}$ wherein R_2 , R_4 , R_5 and Ar are as defined in claim 2.

4. A copolymer according to claim 3, wherein R_2 is linear or branched $\text{C}_1\text{-C}_{40}\text{alkyl}$, or $\text{C}_1\text{-C}_{40}\text{alkyl}$ substituted by one or more halogen, OH , $-\text{N}(\text{C}_1\text{-C}_{20}\text{alkyl})_2$, $-\text{NH-CO-O-C}_2\text{-C}_6\text{alkylene-N}(\text{C}_1\text{-C}_{20}\text{alkyl})_2$, $-\text{NH-CO-O-C}_1\text{-C}_{40}\text{alkylene}$ interrupted by one or more $-\text{O}-$ and Ar is phenyl, toluenyl, pyridyl, imidazolyl.

5. A copolymer according to claim 1, wherein the monomer **MB** has the general formula $\text{CH}_2=\text{C}(\text{R}_{11})\text{-W-Y-Z}$ wherein

R_{11} is hydrogen, halogen or cyano; or R_1 is $\text{C}_1\text{-C}_{18}\text{alkyl}$, $\text{C}_2\text{-C}_{18}\text{alkenyl}$, $\text{C}_3\text{-C}_{18}\text{cycloalkyl}$, $\text{C}_4\text{-C}_{18}\text{cycloalkenyl}$, $\text{C}_6\text{-C}_{24}\text{aryl}$, $\text{C}_1\text{-C}_{12}\text{alkyl-C}_6\text{-C}_{24}\text{aryl}$ or $\text{C}_2\text{-C}_{12}\text{alkenyl-C}_6\text{-C}_{24}\text{aryl}$ each of which optionally is substituted by one or more halogen or OR_3 , SR_3 or NR_4R_5 ; and/or optionally is interrupted by one or more $-\text{O}-$, $-\text{S}-$, $-\text{NR}_4-$;

8. A copolymer MA_r-MB_s according to claim 1 which comprises further monomers MB'_s of the general formula



5 wherein R_1 is hydrogen or methyl and

R_{70} is hydrogen, benzyl, o-chlorobenzyl, o,p-chlorobenzyl, 1-naphtyl, C_1 - C_4 alkyl, C_1 - C_4 alkenyl

Z is Cl^- , Br^- or I^- ; or Z is C_1 - C_{40} alkyl $IC(O)O^-$, C_1 - C_{40} alkenyl $IC(O)O^-$, C_6 - C_{10} aryl $IC(O)O^-$, C_1 - C_{40} alkyl $IS(O)_2O^-$, C_1 - C_{40} alkenyl $IS(O)_2O^-$, C_6 - C_{10} aryl $IS(O)_2O^-$, C_1 - C_{40} alkyl $IP(O)OR_3O^-$ each of which optionally is interrupted by one or more $-O-$.

10

9. A copolymer according to claim 1 made by nitroxide mediated controlled polymerization and having the general formula



wherein

15

In is an initiator fragment capable to initiate radical polymerisation,

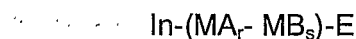
E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the copolymer.

$z = \geq 1$

$t = 1$ to 20.

20

10. A copolymer according to claim 9 made by nitroxide mediated controlled polymerization and having the general formula



wherein

25

In is an initiator fragment capable to initiate radical polymerisation,

E is a group bearing at least one stable free nitroxyl radical, which is bound via the oxygen atom to the copolymer.

11. A copolymer made by controlled polymerisation or by conventional polymerization comprising

at least one monomer (MA_r) selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers,

- 5 **at least one monomer (MB_s)** selected from unsaturated monomers out of the group of acrylates, methacrylates, acrylamides, methacrylamides, styrenic monomers wherein the monomer MB has a quaternized N-atom structure with a polar substituent selected from polyether, polyamine, nitrile, amide, imine, imide, ester, ketone, nitrile, aldehyde, diketone, ketoester, ketoamide, carbonate, carbamate, carbamide, sulfoxide, sulfone, carboxylic acid, 10 sulfonic acid, phosphoric acid groups; or carboxylic acid anion, sulfonic acid anion or phosphoric acid anion groups which is formed as betaine structure

r denotes the total number of monomers MA within the structural element (MA_r) and r is > 5, preferred 10-1000, most preferred 10-500;

- s denotes the total number of monomers MB within the structural element (MB_s) and s is 15 > 1, preferred 2-100, most preferred 2-50.

12. A pigment dispersion in organic solvent dispersed by means of a copolymer of any one of claims 1-11.

20 13. A coating composition comprising:

- a) film forming binder,
- b) pigment,
- c) optionally other conventional coating components and/or additives,
- d) dispersant which is copolymer of any one of claims 1-11, and
- 25 e) an organic solvent.

14. Use of a composition comprising

- a) photo resist binder,
 - b) transparent pigment,
 - 30 c) optionally an organic solvent and/or optionally a photoinitiator or a photolatent catalyst,
 - d) dispersant which is copolymer of any one of claims 1-11
- for producing a color filter.

15. The use of a copolymer according to any one of claims 1-11 to prepare paints, printing inks, inkjet inks, color resists and inkjet inks for color filters.

5 16. The use of a copolymer according to any one of claims 1-11 as a dispersant for pigments in an organic solvent.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/057187

A. CLASSIFICATION OF SUBJECT MATTER
INV. C08F293/00 C08L53/00

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)
C08F C08L

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, 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	WO 03/046029 A (CIBA SC HOLDING AG [CH]; AUSCHRA CLEMENS [DE]; ECKSTEIN ERNST [DE]; ZI) 5 June 2003 (2003-06-05) example 1.1.3	1-14
A	WO 00/40630 A (CIBA SC HOLDING AG [CH]; AUSCHRA CLEMENS [DE]; MUEHLEBACH ANDREAS [CH]) 13 July 2000 (2000-07-13) page 28; table 7	1-14
A	EP 0 329 873 A (DU PONT [US]) 30 August 1989 (1989-08-30) examples 1-4	1-14
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"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

8 September 2009

Date of mailing of the international search report

25/09/2009

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Rouault, Yannick

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/057187

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	I.V. BERLINOVA, I.V. DIMITROV, R.G. KALINOVA, N.G. VLADIMIROV, WEN-FU LEE AND CHUN-HSIUNG L: "Synthesis and aqueous solution behavior of copolymers containing sulfobetaine moieties in side chains" POLYMER, vol. 41, February 2000 (2000-02), pages 831-837, XP002543729 the whole document	1-14
X	WEN-FU LEE, CHUN-HSIUNG LEE: "Poly(sulfobetaine)s and corresponding cationic polymers: 3. Synthesis and dilute aqueous solution properties of poly(sulfobetaine)s derived from styrene-maleic anhydride)" POLYMER, vol. 38, no. 4, February 1997 (1997-02), pages 971-979, XP002543730 the whole document	1-14
X	LEE, WEN-FU; CHEN, YAN-MING I: "Poly(sulfobetaine)s and corresponding cationic polymers. VIII. Synthesis and aqueous solution properties of a cationic poly(methyl iodide quaternized styrene-N, N-dimethylaminopropyl maleamic acid) copolymer" JOURNAL OF APPLIED POLYMER SCIENCE, vol. 80, 16 June 2001 (2001-06-16), pages 1619-1626, XP002543731 the whole document	1-14
X	ANDREW B. LOWE, NORMAN C. BILLINGHAM, STEVEN P. ARMES: "Synthesis and Properties of Low- Polydispersity Poly(sulfopropylbetaine)s and Their Block Copolymers" MACROMOLECULES, vol. 32, 6 April 1999 (1999-04-06), pages 2141-2148, XP002543732 the whole document	1-14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2009/057187

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 1-14(partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search reportcovers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Continuation of Box II.2

Claims Nos.: 1-14(partially)

There are so many groups of invention generated by taking all possible combination for the definition of the claimed products that the claims as a whole are not in compliance with the provisions of clarity and conciseness, as they erect a smoke screen in front of the skilled reader when assessing what should be the subject-matter to search. The non-compliance with the substantive provisions is to such an extent, that a meaningful search of the whole claimed subject-matter could not be carried out, particularly, too many groups of inventions are generated.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/057187

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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