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(54) Titre : POLYCARBONATES ET COPOLYCARBONATES A ADHERENCE AMELIOREE SUR LES METAUX  
(54) Title: POLYCARBONATES AND COPOLYCARBONATES HAVING IMPROVED ADHESION TO METALS

(57) **Abrégé/Abstract:**

The present invention provides polycarbonates and copolycarbonates with a higher glass transition temperature and hence also use temperature and improved metal adhesion, processes for their production and their use for producing blends, moldings and extrudates obtainable therefrom. The invention further provides novel bisphenols and their use for preparing (co)polycarbonates.



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(54) Title: POLYCARBONATES AND COPOLYCARBONATES WITH IMPROVED METAL ADHESION

(54) Bezeichnung: POLYCARBONATE UND COPOLYCARBONATE MIT VERBESSERTER METALLHAFTUNG

(57) Abstract: The present invention provides polycarbonates and copolycarbonates with a higher glass transition temperature and hence also use temperature and improved metal adhesion, processes for their production and their use for producing blends, moldings and extrudates obtainable therefrom. The invention further provides novel bisphenols and their use for preparing (co)polycarbonates.

(57) Zusammenfassung: Gegenstand der vorliegenden Erfindung sind Polycarbonate und Copolycarbonate mit höherer Glas- und damit auch Gebrauchstemperatur und verbesserter Metallhaftung, Verfahren zu deren Herstellung und deren Verwendung zur Herstellung von Blends, Formteilen und Extrudate erhältlich daraus. Gegenstand der Erfindung sind weiterhin neue Bisphenole und deren Verwendung zur Herstellung von (Co-)Polycarbonaten.



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**Polycarbonates and copolycarbonates having improved adhesion to metals**

5 The present invention provides polycarbonates and copolycarbonates having a relatively high glass transition temperature and therefore also use temperature and improved adhesion to metals, processes for the preparation thereof and the use thereof for the preparation of blends, and mouldings and extrudates obtainable therefrom. The invention furthermore provides two novel bisphenols and the use  
10 thereof for the preparation of (co)polycarbonates.

Aromatic polycarbonates belong to the group of industrial thermoplastics. They are distinguished by combination of the technologically important properties of transparency, heat distortion resistance and toughness.

15

To obtain high molecular weight polycarbonates by the phase interface process, the alkali metal salts of bisphenols are reacted with phosgene in the two-phase mixture. The molecular weight can be controlled by the amount of monophenols, such as e.g. phenol or tert-butylphenol. Practically exclusively linear polymers are formed in  
20 these reactions. This can be demonstrated by end group analysis. By targeted use of so-called branching agents, as a rule polyhydroxylated compounds, branched polycarbonates are also obtained in this context.

For the preparation of polycarbonates by the phase interface process, reference may  
25 be made by way of example to H. Schnell, Chemistry and Physics of Polycarbonates, Polymer Reviews, vol. 9, Interscience Publishers, New York 1964 p. 33 et seq. and to Polymer Reviews, vol. 10, "Condensation Polymers by Interfacial and Solution Methods", Paul W. Morgan, Interscience Publishers, New York 1965, chap. VIII, p. 325.

30

For the preparation of polycarbonates by the melt transesterification process, the bisphenols are reacted in the melt with diaryl carbonates, usually diphenyl

carbonate, in the presence of catalysts, such as alkali metal salts or ammonium or phosphonium compounds.

5 The melt transesterification process is described, for example, in the Encyclopedia of Polymer Science, vol. 10 (1969), Chemistry and Physics of Polycarbonates, Polymer Reviews, H. Schnell, vol. 9, John Wiley and Sons, Inc. (1964) and DE-C 10 31 512.

10 Polycarbonates based on 2-hydrocarbyl-3,3-bis(4-hydroxyaryl)phthalimidines as monomers, which can be prepared by synthesis from phenolphthalein and an aniline hydrochloride derivative in aniline, are known from EP-A 1 582 549. This preparation is very involved and does not proceed satisfactorily. This bisphenol class thus has the industrial disadvantage of being accessible in only a very cumbersome manner.

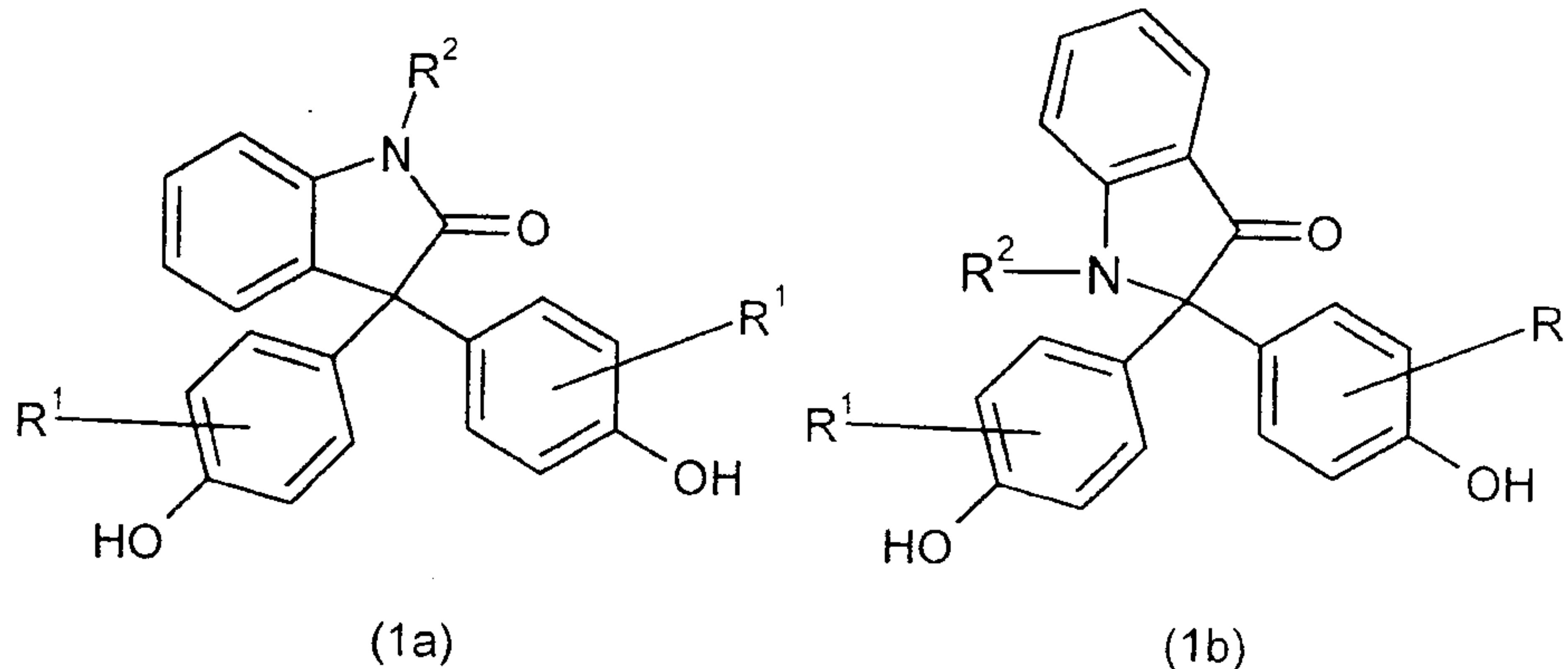
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However, due to their lack of adhesion to metals, the polycarbonates and copolycarbonates already described in the prior art have the disadvantage that they may have only a limited suitability or a suitability which is not optimum for use as a metallized component in e.g. high temperature uses.

20

There was therefore the object of providing polycarbonates or copolycarbonates and processes for the preparation thereof which avoid these disadvantages. This object is achieved, surprisingly, by the use of the class according to the invention of bisphenols of the general formulae (1a) and (1b) (isomer mixture) (also called  
25 bisphenols of the formula (1) in the following)

- 3 -



in which

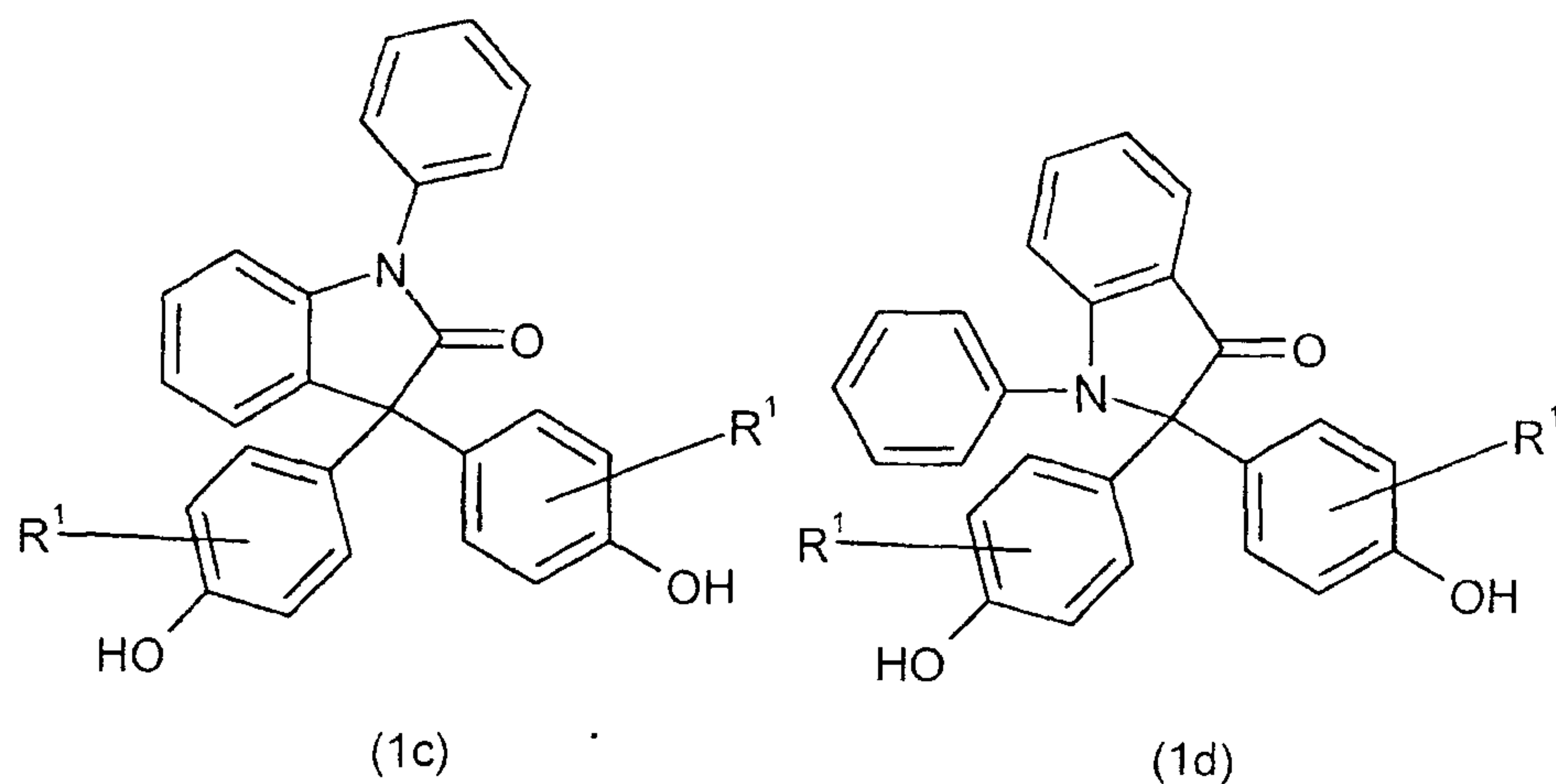
5  $R^1$  independently of one another represents hydrogen or  $C_1$ - $C_{10}$  alkyl, preferably hydrogen or  $C_1$ - $C_6$  alkyl, particularly preferably hydrogen or  $C_1$ - $C_4$  alkyl, very particularly preferably hydrogen or methyl,

10  $R^2$  represents  $C_1$ - $C_{10}$  alkyl, preferably  $C_1$ - $C_6$  alkyl, particularly preferably  $C_1$ - $C_4$  alkyl, or in each case optionally substituted phenyl or benzyl, in particular methyl, phenyl or benzyl, wherein the radicals mentioned for  $R^1$  are preferred as substituents for phenyl and benzyl.

Alkyl in the context of the present invention is in each case linear or branched.

15 Particularly preferably,  $R^2$  represents phenyl which is optionally substituted by the radicals mentioned in  $R^1$ , represented by the formula (1c) and (1d) (isomer mixture)

- 4 -

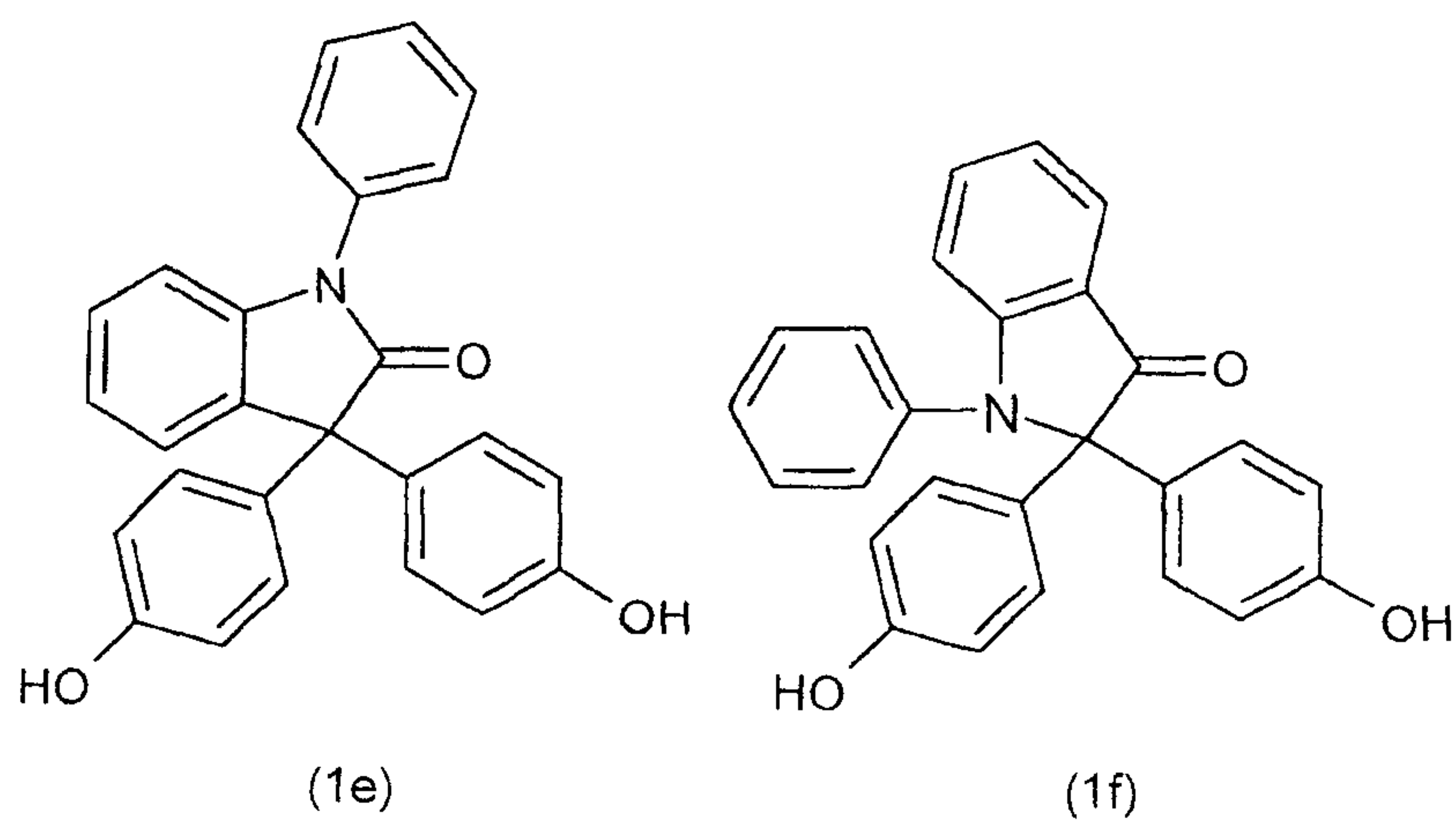


wherein

R<sup>1</sup> has the abovementioned meaning.

5

The bisphenol of the formula (1e) and (1f) (isomer mixture)



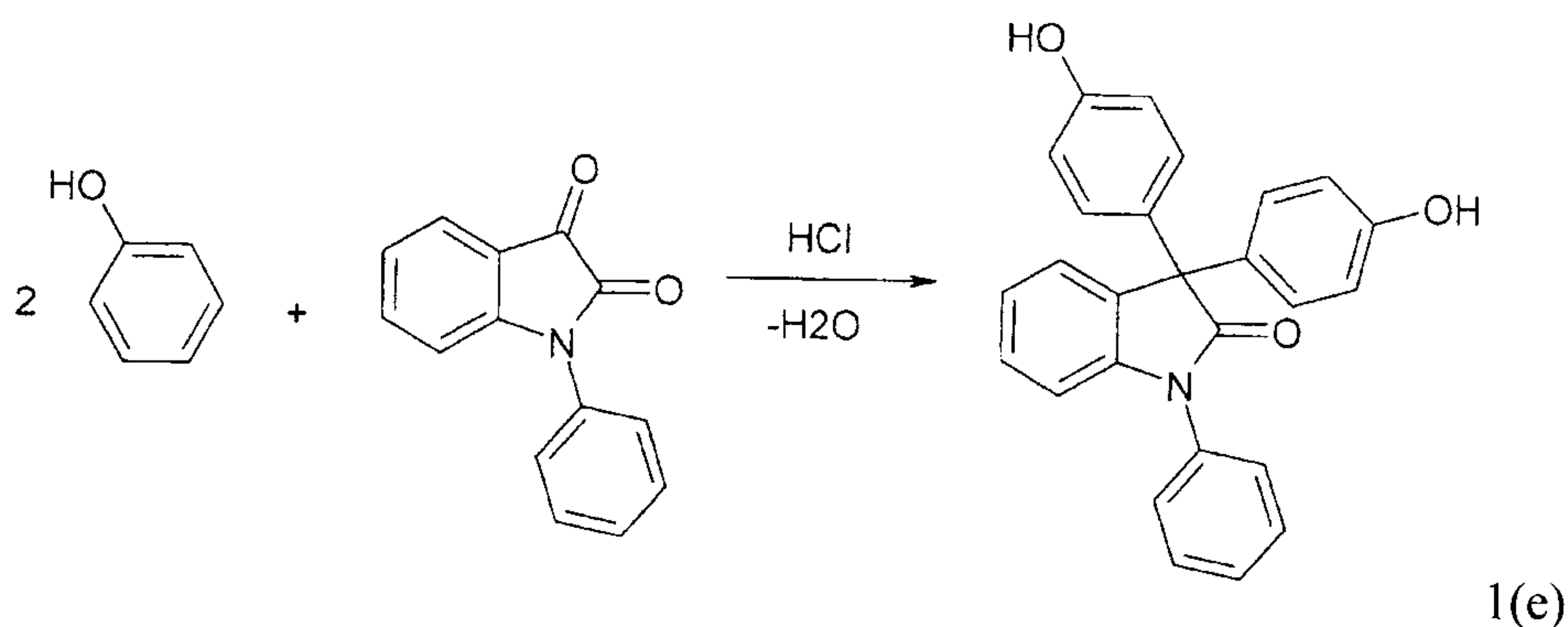
is very particularly preferred.

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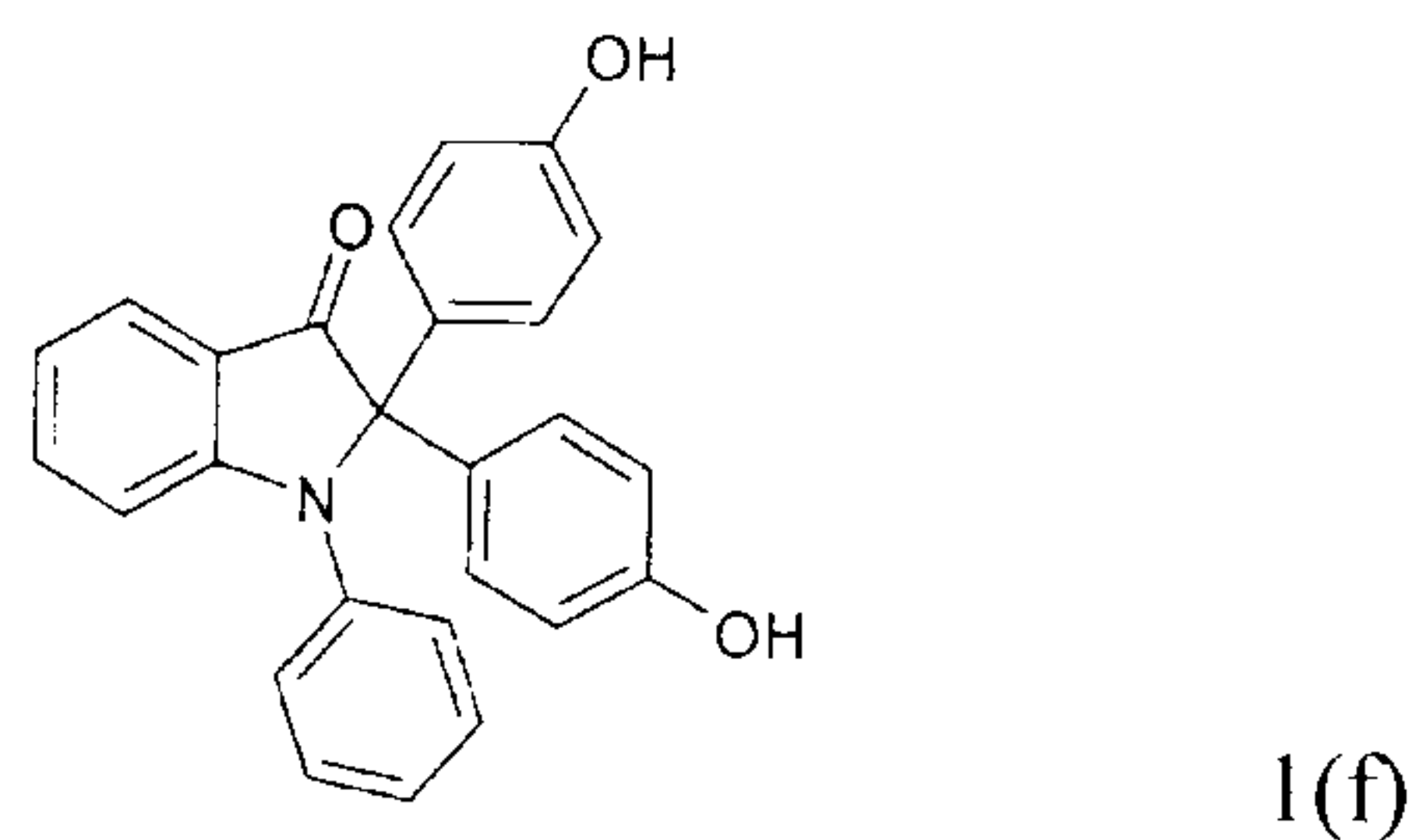
These bisphenols of the formula (I) according to the invention can be prepared from phenol derivatives and N-substituted isatin derivatives in an acid-catalyzed reaction. This can be carried out by means of reactions analogous to that which is described for the preparation of unsubstituted isatin-bisphenols (H. N. Song et al., Synthetic

Communications 1999, 29 (19), 3303 and R. Berendes, H. Klös, Patent Specification No. 488760, Patent Office of the German Reich 1930).

The synthesis of the bisphenols according to the invention is preferably carried out as a condensation reaction of corresponding phenols and isatin derivatives, as the following example shows:



3,3-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-2-one



2,2-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-3-one,

an isomer mixture being obtained.

Very particularly preferably, the condensation is carried out with hydrochloric acid as the acid catalyst at temperatures of between 0 and 60 °C with a stoichiometric ratio of phenol derivative to ketone derivative of 10 to 1, a mercaptan or thiocarboxylic acid compound (e.g. dodecylmercaptan, mercaptopropionic acid or thioacetic acid) preferably being present as a sulfur-containing compound, preferably only in an amount of about 0.01 to 25 %, based on the ketone compound. The hydrochloric acid is very particularly preferably passed in as HCl gas.

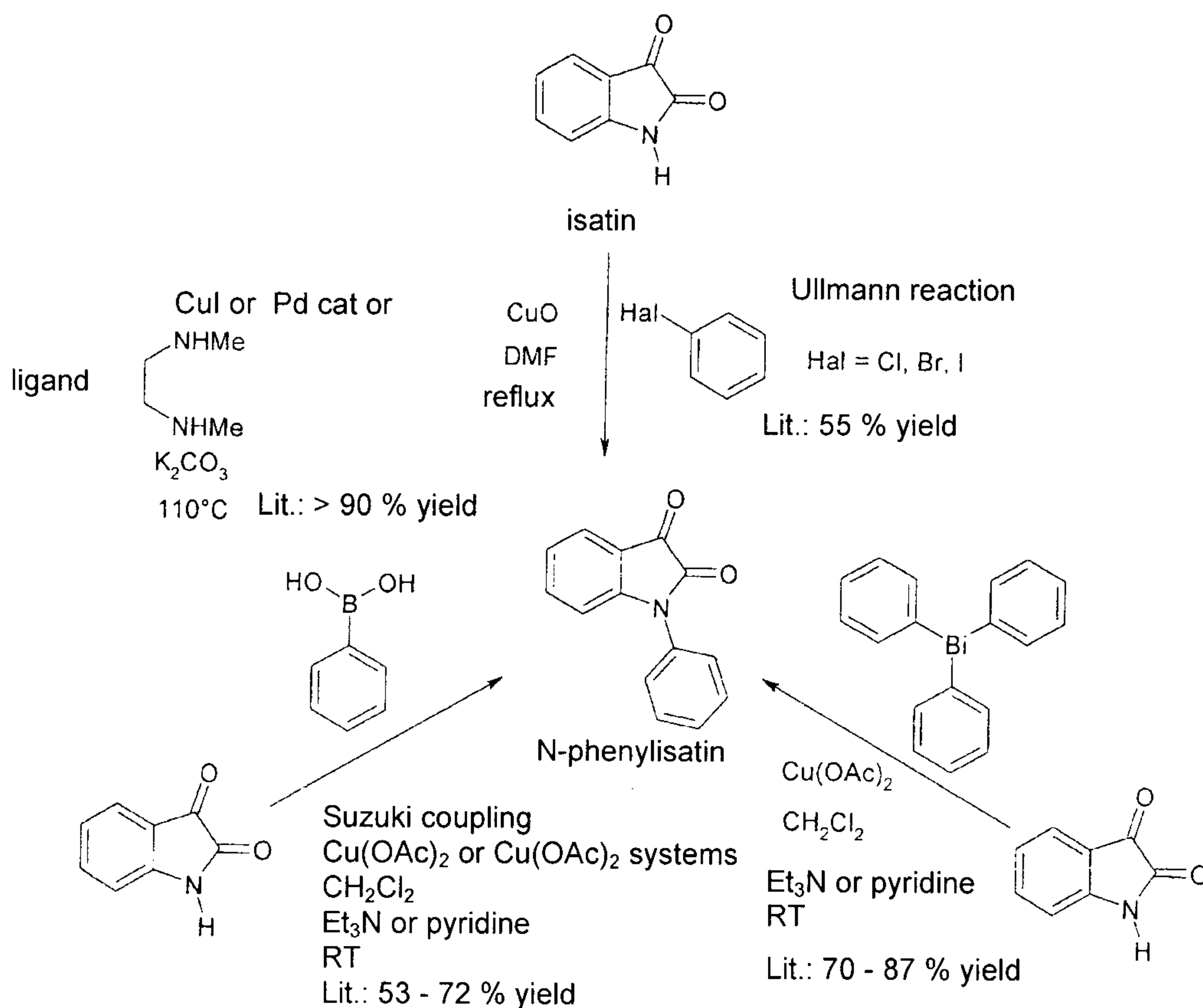
The condensation can be carried out in substance or in solution. In this context, inert solvents, such as, for example, chlorinated hydrocarbons, such as methylene chloride or dichloroethane, or toluene, xylenes or chlorobenzenes, are employed.

5

The reaction is particularly preferably carried out in substance with an excess of phenol.

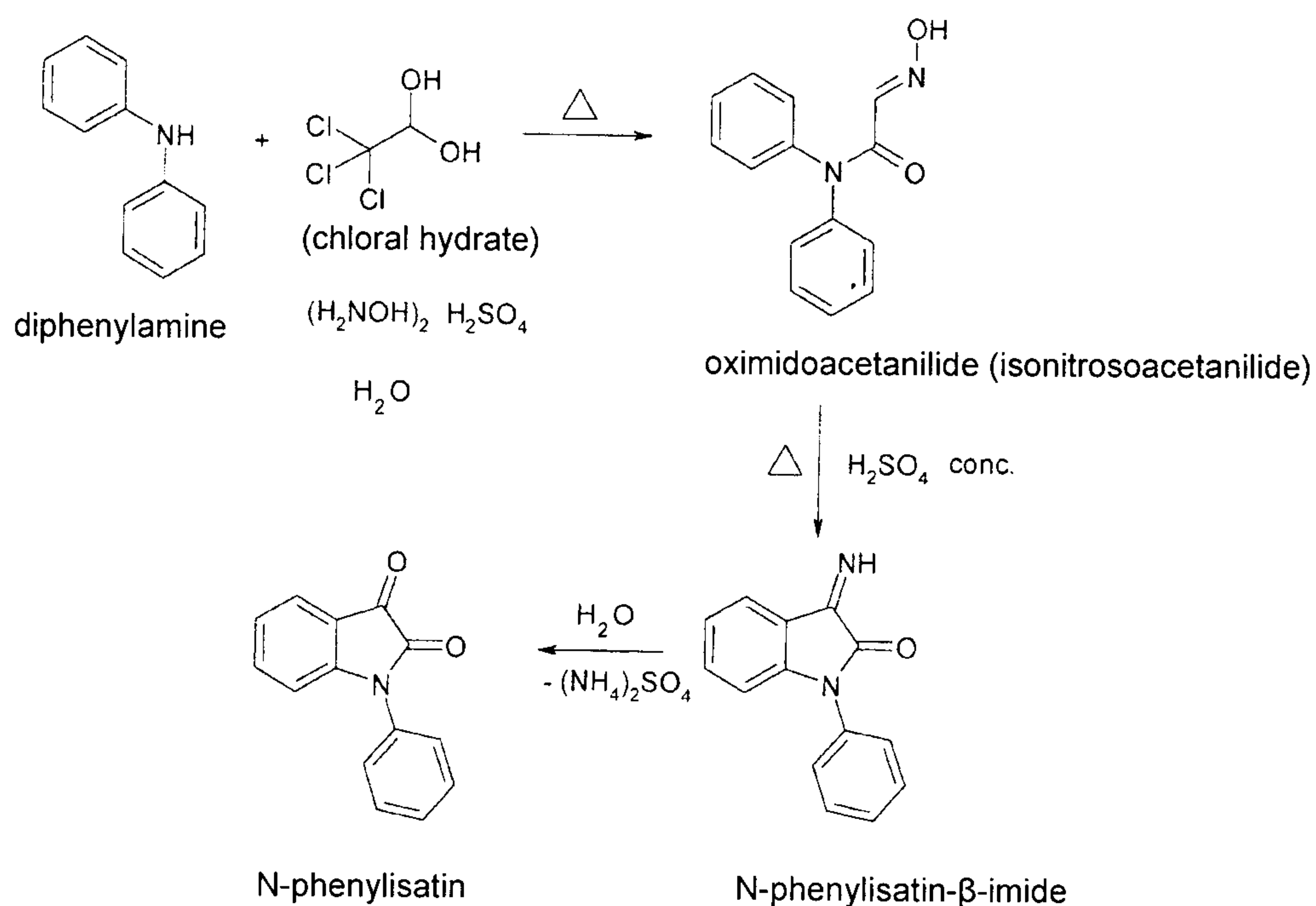
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A further synthesis possibility for the preparation of N-phenylisatin is the use of commercially obtainable isatin (e.g. BASF AG) in the form of an N-arylation reaction. The following organometallic syntheses known from the literature are available in this context.



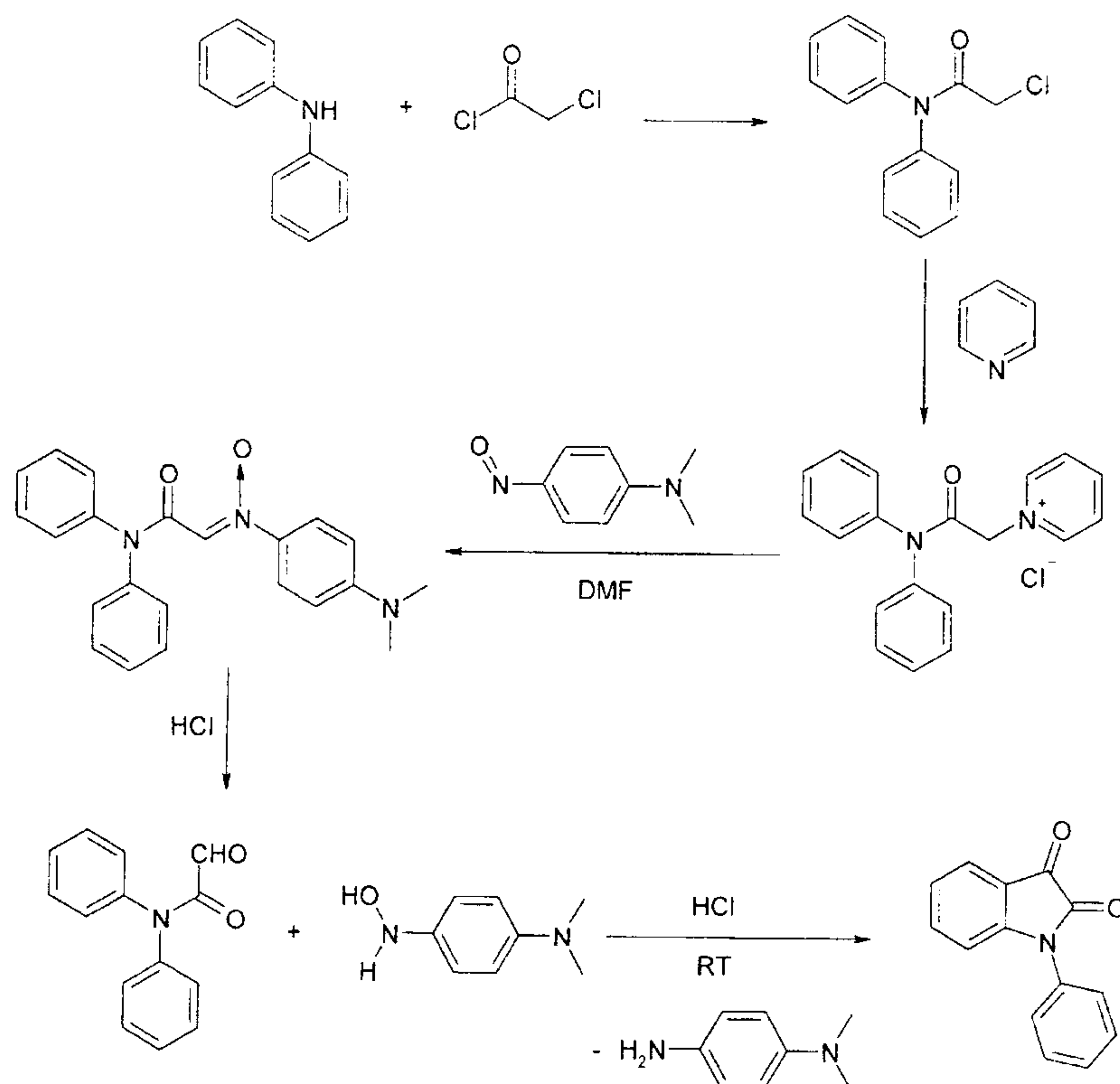
- 7 -

A further synthesis possibility for the preparation of N-phenylisatin is the use of the isonitrosoacetanilide isatin process (formerly for the preparation of indigo, Traugott Sandmeyer, Geigy Basel 1919). The following reaction steps are carried out in this:



A further synthesis possibility for the preparation of N-phenylisatin is via the reaction stage of a nitron. The following reaction steps are carried out in this:

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The phenols employed are known or can be prepared by processes known from the literature, for example by Friedel Crafts alkylation (Organikum, Organisch-chemisches Grundpraktikum, corrected reprint of the 20th edition, Wiley-VCH, Weinheim, p. 355, 1999). Very many phenols are also commercially obtainable (suppliers e.g. Aldrich, Fluka, Acros etc.).

The isatin derivatives used are likewise known or can be prepared by processes known from the literature, for example by alkylation of the corresponding isatin parent substance. For example, they are accessible from the corresponding sodium or potassium salts of the isatin parent substance by reaction with alkyl halides in absolute alcohol (G. Heller, O. Nötzel, Ber. Dtsch. Chem. Ges. 1907, 40, 1294). An alternative synthesis possibility is offered by alkylation via O-alkylated isourea derivatives (E. Vowinkel, Chem. Ber. 1966, 99, 1479, or L. J. Mathia, Synthesis 1979, 561). These can be obtained by reaction of N,N'-dicyclohexylcarbodiimide with an alcohol in the presence of copper(I) chloride (E. Schmidt, F. Moosmüller,

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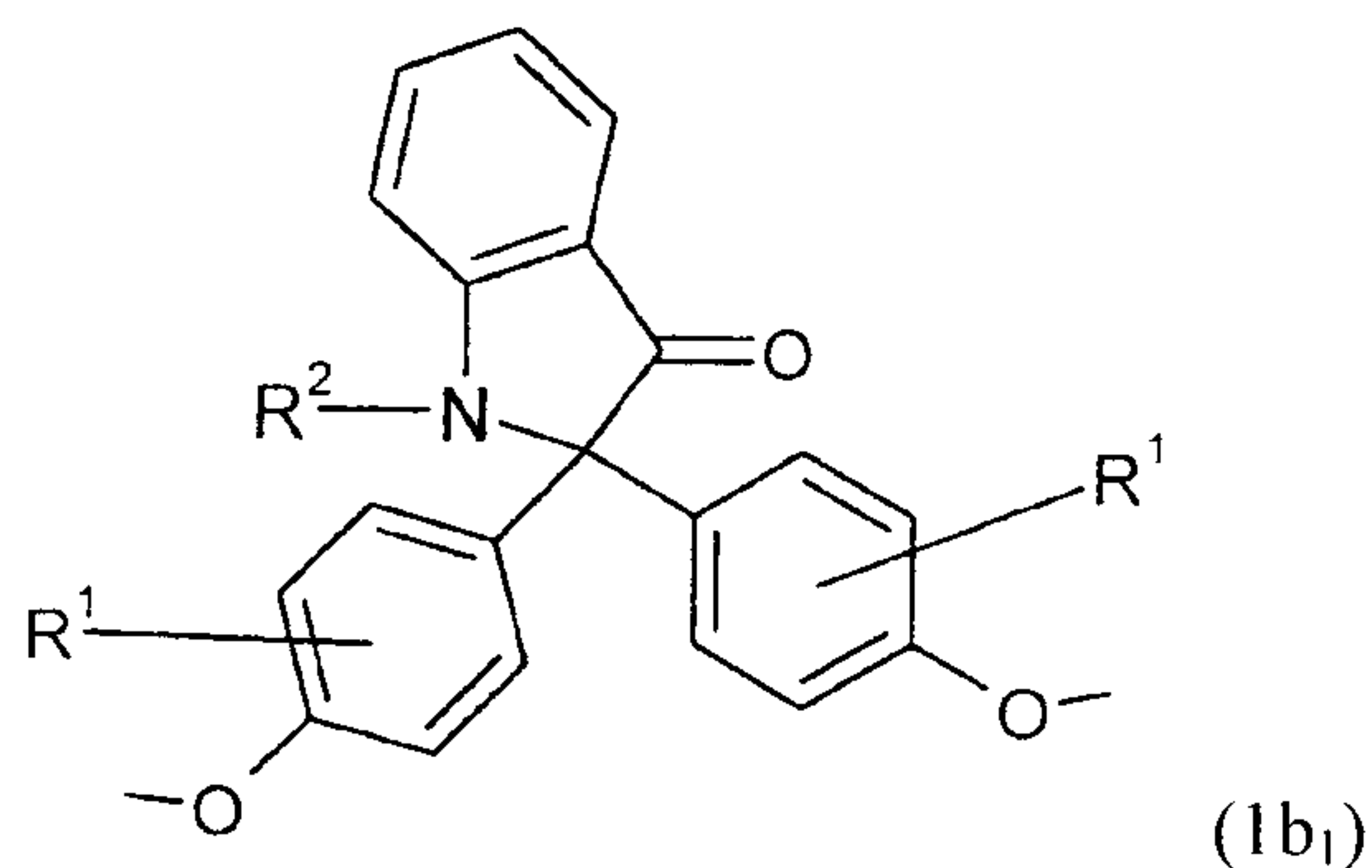
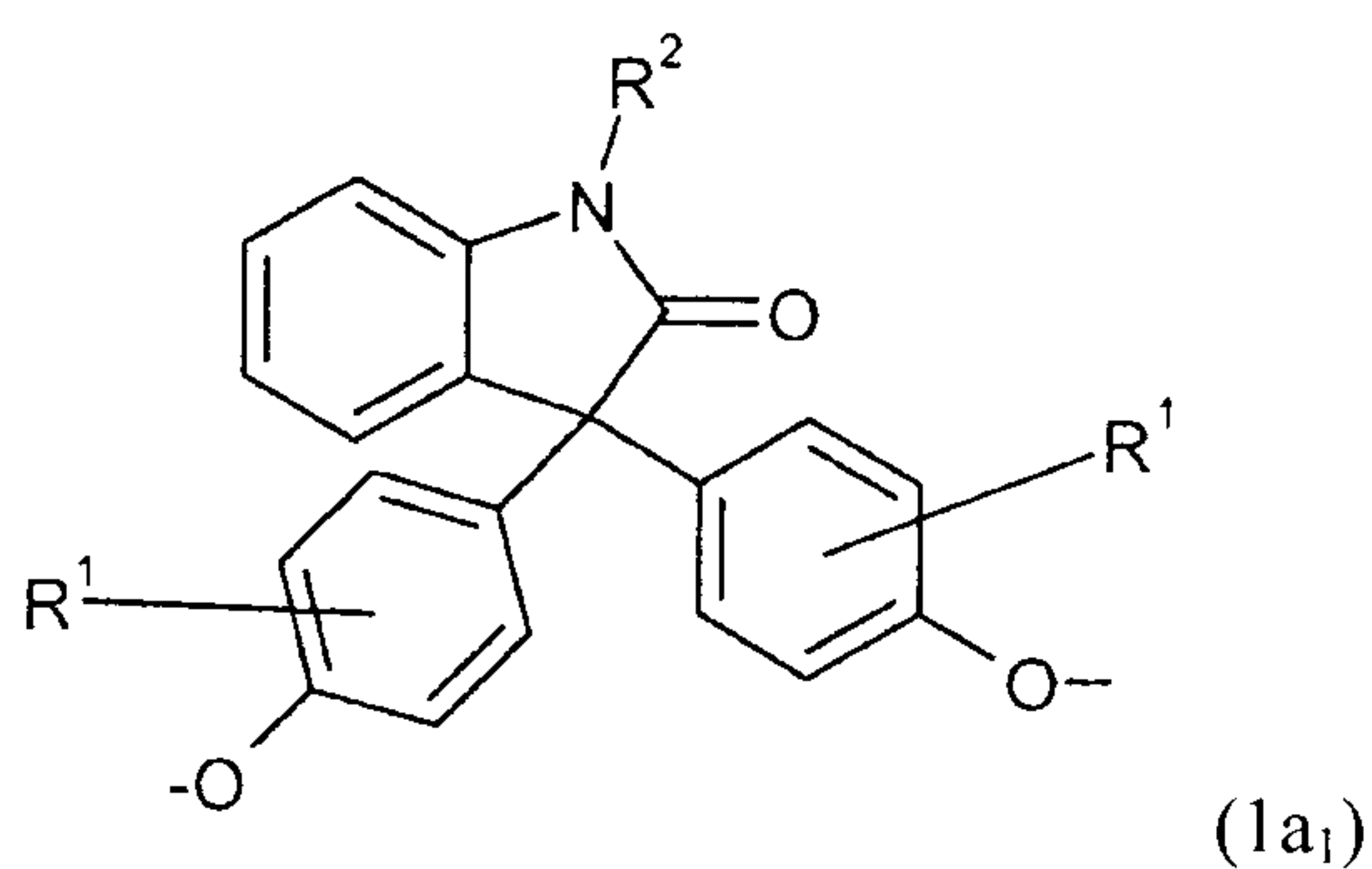
Liebigs Ann. Chem. 1955, 597, 235). Some N-substituted isatins are also commercially obtainable (suppliers e.g. ChemPur GmbH, Karlsruhe, Germany or Alfa Aesar, Karlsruhe, German or Sigma-Aldrich or Lancaster Synthesis Ltd. Newgate, United Kingdom).

5

The present invention likewise provides polycarbonates or copolycarbonates which are prepared using the bisphenols according to the invention, and the corresponding preparation processes.

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The (co)polycarbonates according to the invention are based on bisphenols of the general formulae (1a<sub>I</sub>) and (1b<sub>I</sub>) (isomer mixture) as a recurring monomer unit



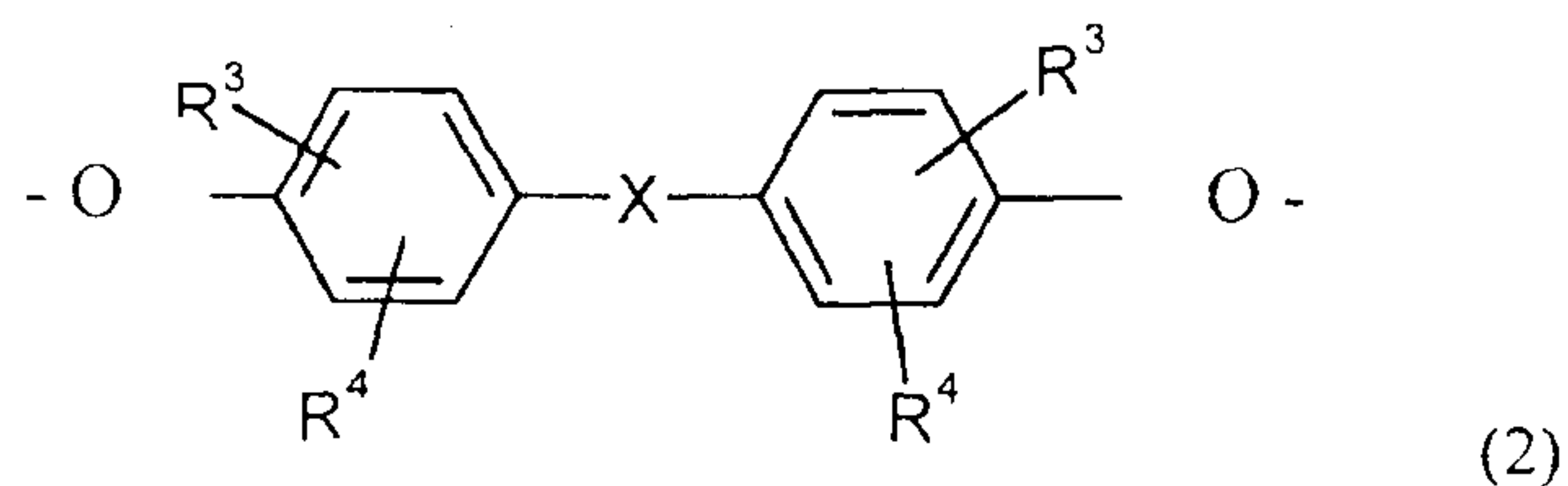
wherein

15 R<sup>1</sup> and R<sup>2</sup> have the abovementioned meaning.

Preferred bisphenols are likewise those mentioned above.

- 10 -

In the case of (co)polycarbonates, in addition to one or more bisphenols of the formula (1), these can contain as a further monomer unit bisphenols of the formula (2)

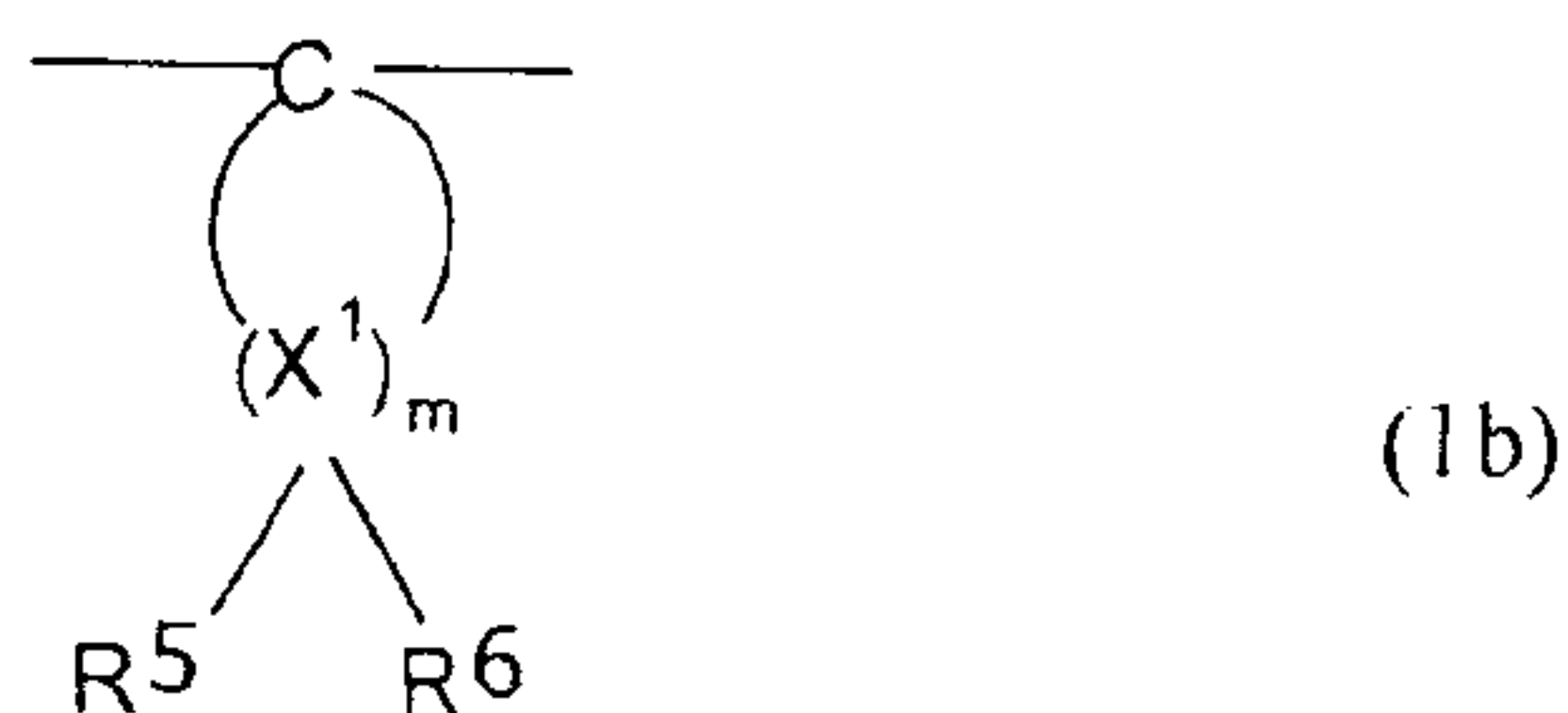


5 in which

$R^3$  and  $R^4$  independently of one another represent H,  $C_1$ - $C_{18}$ -alkyl,  $C_1$ - $C_{18}$ -alkoxy, halogen, such as Cl or Br, or in each case optionally substituted aryl or aralkyl, preferably H or  $C_1$ - $C_{12}$ -alkyl, particularly preferably H or  $C_1$ - $C_8$ -alkyl and very particularly preferably H or methyl, and

X represents a single bond,  $-SO_2-$ ,  $-CO-$ ,  $-O-$ ,  $-S-$ ,  $C_1$ - to  $C_6$ -alkylene,  $C_2$ - to  $C_5$ -alkylidene or  $C_5$ - to  $C_6$ -cycloalkylidene, which can be substituted by  $C_1$ - to  $C_6$ -alkyl, preferably methyl or ethyl, or furthermore  $C_6$ - to  $C_{12}$ -arylene, which can optionally be fused with further aromatic rings containing hetero atoms.

Preferably, X represents a single bond,  $C_1$  to  $C_5$ -alkylene,  $C_2$  to  $C_5$ -alkylidene,  $C_5$  to  $C_6$ -cycloalkylidene,  $-O-$ ,  $-SO-$ ,  $-CO-$ ,  $-S-$ ,  $-SO_2-$  or a radical of the formula (1b)



20

wherein

$R^5$  and  $R^6$  can be chosen individually for each  $X^1$  and independently of one another denote hydrogen or  $C_1$  to  $C_6$ -alkyl, preferably hydrogen, methyl or ethyl, and

- 11 -

X<sup>1</sup> denotes carbon and

m denotes an integer from 4 to 7, preferably 4 or 5, with the proviso that on at  
5 least one atom X<sup>1</sup>, R<sup>5</sup> and R<sup>6</sup> are simultaneously alkyl.

Examples which are mentioned of the diphenols of the formula (2) which can be employed in addition to the bisphenols of the formula (1) according to the invention are hydroquinone, resorcinol, dihydroxybiphenyls, bis-(hydroxyphenyl)-alkanes,  
10 bis-(hydroxyphenyl)-cycloalkanes, bis-(hydroxyphenyl) sulfides, bis-(hydroxyphenyl) ethers, bis-(hydroxyphenyl) ketones, bis-(hydroxyphenyl) sulfones, bis-(hydroxyphenyl) sulfoxides,  $\alpha,\alpha'$ -bis-(hydroxyphenyl)-diisopropylbenzenes and compounds thereof alkylated on the nucleus and halogenated on the nucleus, and also  $\alpha,\omega$ -bis-(hydroxyphenyl)-polysiloxanes.

15 Preferred diphenols of the formula (2) are, for example, 4,4'-dihydroxybiphenyl (DOD), 4,4'-dihydroxybiphenyl ether (DOD ether), 2,2-bis-(4-hydroxyphenyl)-propane (bisphenol A), 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane (bisphenol TMC), 1,1-bis-(4-hydroxyphenyl)-cyclohexane, 2,4-bis-(4-  
20 hydroxyphenyl)-2-methylbutane, 1,1-bis-(4-hydroxyphenyl)-1-phenylethane, 1,1-bis[2-(4-hydroxyphenyl)-2-propyl]-benzene, 1,3-bis[2-(4-hydroxyphenyl)-2-propyl]-benzene (bisphenol M), 2,2-bis-(3-methyl-4-hydroxyphenyl)-propane, 2,2-bis-(3-chloro-4-hydroxyphenyl)-propane, bis-(3,5-dimethyl-4-hydroxyphenyl)-methane, 2,2-bis-(3,5-dimethyl-4-hydroxyphenyl)-propane, bis-(3,5-dimethyl-4-hydroxy-  
25 phenyl) sulfone, 2,4-bis-(3,5-dimethyl-4-hydroxyphenyl)-2-methylbutane, 2,2-bis-(3,5-dichloro-4-hydroxyphenyl)-propane and 2,2-bis-(3,5-dibromo-4-hydroxyphenyl)-propane.

Particularly preferred bisphenols are, for example, 2,2-bis-(4-hydroxyphenyl)-  
30 propane (bisphenol A), 4,4'-dihydroxybiphenyl (DOD), 4,4'-dihydroxybiphenyl ether (DOD ether), 1,3-bis[2-(4-hydroxyphenyl)-2-propyl]-benzene (bisphenol M),

- 12 -

2,2-bis-(3,5-dimethyl-4-hydroxyphenyl)-propane, 1,1-bis-(4-hydroxyphenyl)-1-phenylethane, 2,2-bis-(3,5-dichloro-4-hydroxyphenyl)-propane, 2,2-bis-(3,5-dibromo-4-hydroxyphenyl)-propane, 1,1-bis-(4-hydroxyphenyl)-cyclohexane and 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane (bisphenol TMC).

5

2,2-Bis-(4-hydroxyphenyl)-propane (bisphenol A), 4,4'-dihydroxybiphenyl (DOD), 1,3-bis[2-(4-hydroxyphenyl)-2-propyl]-benzene (bisphenol M) and 1,1-bis-(4-hydroxyphenyl)-3,3,5-trimethylcyclohexane (bisphenol TMC) are very particularly preferred.

10

The bisphenols of the formula (1) can be used either alone or in a mixture with one another or in a mixture with one or more bisphenols of the formula (2); polycarbonates in the context of the present invention are to be understood as meaning both homopolycarbonates and copolycarbonates.

15

Copolycarbonates in general contain, in addition to a diphenol chosen from compounds of the formula (1), up to 95 mol%, preferably up to 80 mol%, particularly preferably up to 70 mol% of at least one further diphenol chosen from compounds of the formula (2) (based on the sum of the moles of diphenols employed). The copolycarbonates preferably contain as the lower limit at least 5 mol%, in particular 10 mol% (based on the sum of the moles of diphenols employed) chosen from compounds of the formula (2). Particularly preferred copolycarbonates contain 40-60, in particular 45-55 mol% of diphenol of the formula (1) and 60-40, in particular 45-55 mol% of diphenol of the formula (2) (based on the sum of the moles of diphenols employed).

20

25

The copolycarbonate can also be prepared, in particular, from a mixture of three bisphenols, one originating from the class of N-substituted isatin-bisphenols and the other two originating from the bisphenols described above. This is very particularly preferably the combination of the bisphenol structure (1b) with bisphenol A and bisphenol TMC. In this context, compositions of 50 mol% of bisphenol A, 25 mol%

30

of the bisphenol from the class of N-substituted isatin-bisphenols and 25 mol% of TMC are very particularly preferred.

5 The polycarbonates and copolycarbonates according to the invention in general have average molecular weights (weight-average) of from 2,000 to 200,000, preferably 3,000 to 150,000, in particular 5,000 to 100,000, very particularly preferably 8,000 to 80,000, in particular 12,000 to 70,000 (determined by GPC with polycarbonate calibration).

10 The diphenols are known from the literature or can be prepared by processes known from the literature (see e.g. H. J. Buysch et al., Ullmann's Encyclopedia of Industrial Chemistry, VCH, New York 1991, 5th ed., vol. 19, p. 348).

15 The polycarbonates and copolycarbonates can also be branched. Certain small amounts, preferably amounts of between 0.05 and 5 mol%, particularly preferably 0.1 to 3 mol%, very particularly preferably 0.1 to 2 mol%, based on the moles of diphenols employed, of trifunctional compounds, such as e.g. isatin-bisresol (IBC) or phloroglucinol, 4,6-dimethyl-2,4,6-tri(4-hydroxyphenyl)-hep-2-ene; 4,6-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-heptane; 1,3,5-tri-(4-hydroxyphenyl)-benzene; 20 1,1,1-tri-(4-hydroxyphenyl)-ethane (THPE); tri-(4-hydroxyphenyl)-phenylmethane; 2,2-bis-[4,4-bis-(4-hydroxyphenyl)-cyclohexyl]-propane; 2,4-bis-(4-hydroxyphenyl-isopropyl)-phenol; 2,6-bis-(2-hydroxy-5'-methyl-benzyl)-4-methylphenol; 2-(4-hydroxyphenyl)-2-(2,4-dihydroxyphenyl)-propane; hexa-(4-(4-hydroxyphenyl-isopropyl)-phenyl)-orthoterephthalic acid ester; tetra-(4-hydroxyphenyl)-methane, 25 tetra-(4-(4-hydroxyphenyl-isopropyl)-phenoxy)-methane;  $\alpha,\alpha',\alpha''$ -tris-(4-hydroxyphenyl)-1,3,5-triisopropylbenzene; 2,4-dihydroxybenzoic acid; trimesic acid; cyanuric chloride; 3,3-bis-(3-methyl-4-hydroxyphenyl)-2-oxo-2,3-dihydroindole; 1,4-bis-(4',4''-dihydroxytriphenyl)-methyl)-benzene and, in particular: 1,1,1-tri-(4-hydroxyphenyl)-ethane and bis-(3-methyl-4-hydroxyphenyl)-2-oxo-2,3-dihydro- 30 indole are employed as so-called branching agents for this purpose. Isatin-bisresol

and 1,1,1-tri-(4-hydroxyphenyl)-ethane and bis-(3-methyl-4-hydroxyphenyl)-2-oxo-2,3-dihydroindole are preferably employed as branched agents.

5 The use of these branching agents results in branched structures. The resulting long-chain branching leads to rheological properties of the polycarbonates obtained which manifest themselves in a structural viscosity compared with linear types.

10 The present invention furthermore relates to a process for the preparation of the polycarbonates and copolycarbonates according to the invention, characterized in that bisphenols and, where appropriate, branching agents are dissolved in aqueous alkaline solution and are reacted with a source of carbonate, such as phosgene, optionally dissolved in a solvent, in a two-phase mixture of an aqueous alkaline solution, an organic solvent and a catalyst, preferably an amine compound. The reaction procedure can also be in several stages. Such processes for the preparation of polycarbonate are known in principle as the two-phase interface process e.g. from 15 H. Schnell, Chemistry and Physics of Polycarbonates, Polymer Reviews, vol. 9, Interscience Publishers, New York 1964 p. 33 et seq. and from Polymer Reviews, vol. 10, "Condensation Polymers by Interfacial and Solution Methods", Paul W. Morgan, Interscience Publishers, New York 1965, chap. VIII, p. 325, and the person 20 skilled in the art is therefore familiar with the basic conditions.

In this context, the concentration of the bisphenols in the aqueous alkaline solution is 2 to 25 wt.%, preferably 2 to 20 wt.%, particularly preferably 2 to 18 wt.% and very particularly preferably 3 to 15 wt.%. The aqueous alkaline solution comprises 25 water, in which hydroxides of alkali or alkaline earth metals are dissolved. Sodium hydroxide and potassium hydroxide are preferred.

If phosgene is used as the source of carbonate, the volume ratio of aqueous alkaline solution to organic solvent is 5:95 to 95:5, preferably 20:80 to 80:20, particularly 30 preferably 30:70 to 70:30 and very particularly preferably 40:60 to 60:40. The 30 molar ratio of bisphenol to phosgene is less than 1:10, preferably less than 1:6,

particularly preferably less than 1:4 and very particularly preferably less than 1:3. The concentration of the branched polycarbonates and copolycarbonates according to the invention in the organic phase is 1.0 to 25 wt.%, preferably 2 to 20 wt.%, particularly preferably 2 to 18 wt.% and very particularly preferably 3 to 15 wt.%.

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The concentration of the amine compound, based on the amount of bisphenol employed, is 0.1 to 10 mol%, preferably 0.2 to 8 mol%, particularly preferably 0.3 to 6 mol% and very particularly preferably 0.4 to 5 mol%.

10

Bisphenols are to be understood as meaning the abovementioned diphenols, with contents of the abovementioned branching agents. The source of carbonate is phosgene, diphosgene or triphosgene, preferably phosgene. In the case where phosgene is employed, a solvent can optionally be dispensed with and the phosgene can be passed directly into the reaction mixture.

15

Tertiary amines, such as triethylamine or N-alkylpiperidines, can be employed as the catalyst. Trialkylamines and 4-(dimethylamino)pyridine are suitable as catalysts. Triethylamine, tripropylamine, triisopropylamine, tributylamine, triisobutylamine, N-methylpiperidine, N-ethylpiperidine and N-propylpiperidine are particularly

20

suitable. Halogenated hydrocarbons, such as methylene chloride and/or chlorobenzene, dichlorobenzene, trichlorobenzene or mixtures thereof, or aromatic hydrocarbons, such as e.g. toluene or xylenes, are possible as the organic solvent.

25

The reaction temperature can be -5 °C to 100 °C, preferably 0 °C to 80 °C, particularly preferably 10 °C to 70 °C and very particularly preferably 10 °C to 60 °C.

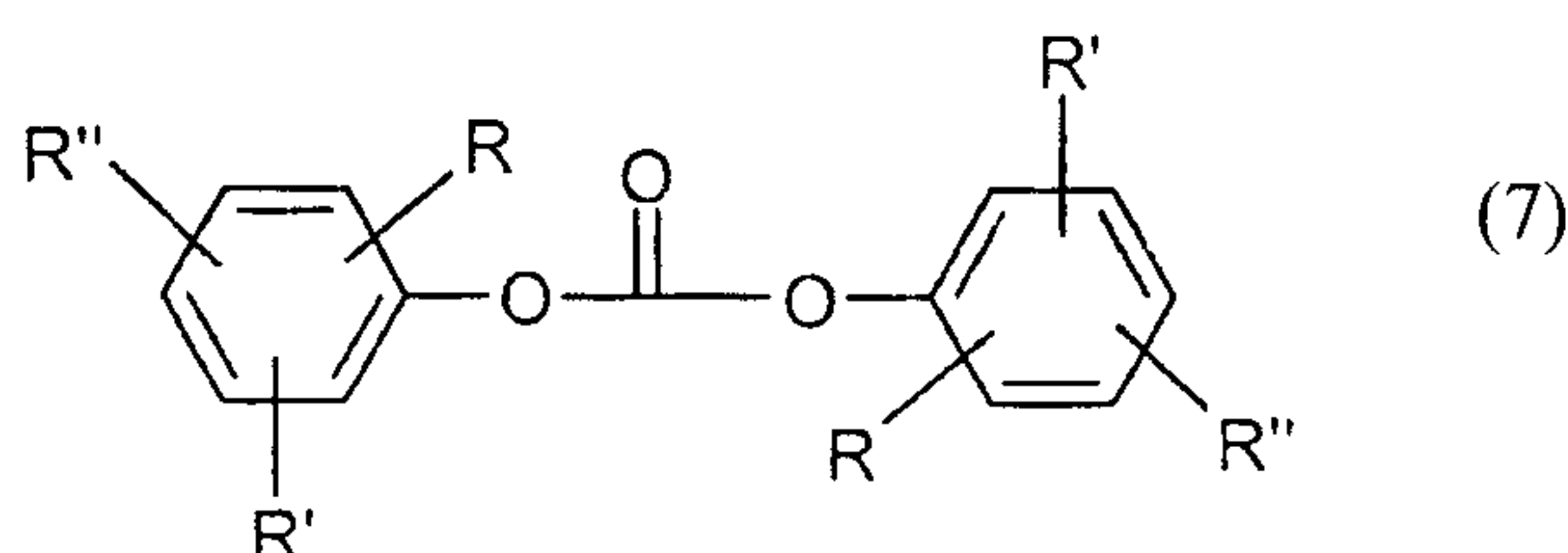
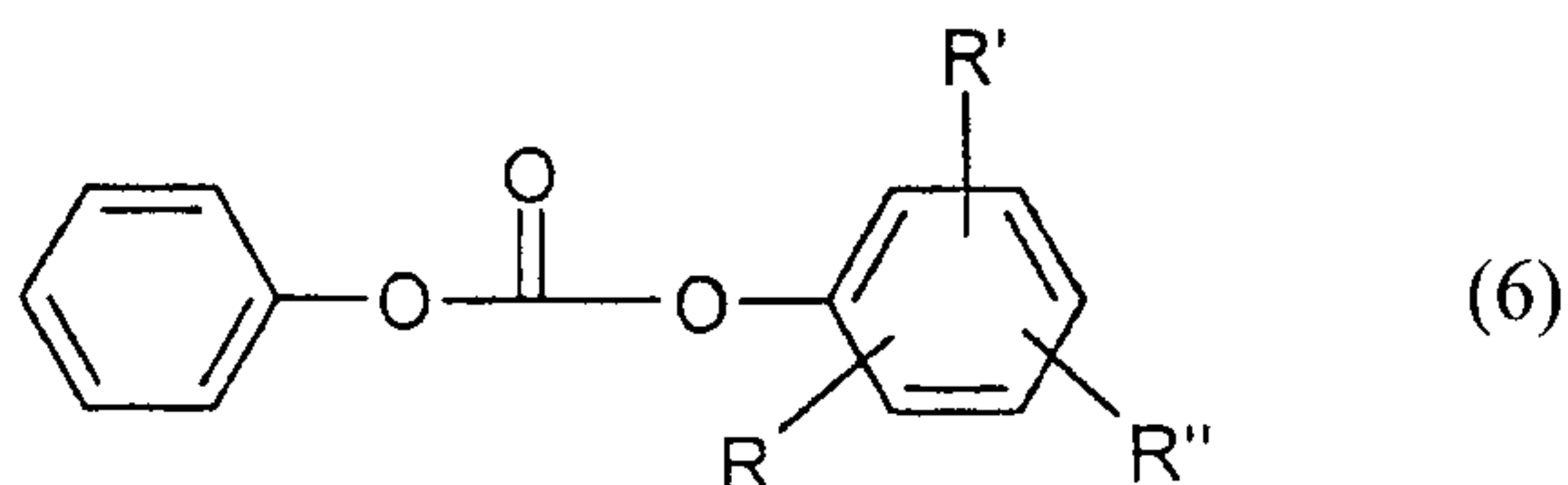
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Alternatively, the polycarbonates according to the invention can also be prepared by the melt transesterification process. The melt transesterification process is

described, for example, in the Encyclopedia of Polymer Science, vol. 10 (1969), Chemistry and Physics of Polycarbonates, Polymer Reviews, H. Schnell, vol. 9, John Wiley and Sons, Inc. (1964) and DE-C 10 31 512.

- 5 In the melt transesterification process, the aromatic dihydroxy compounds already described for the phase interface process are transesterified in the melt with carbonic acid diesters with the aid of suitable catalysts and optionally further additives.

10 Carbonic acid diesters in the context of the invention are those of the formula (6) and (7)



wherein

- 15 R, R' and R'' independently of one another can represent H, optionally branched C<sub>1</sub>-C<sub>34</sub>-alkyl/cycloalkyl, C<sub>7</sub>-C<sub>34</sub>-alkaryl or C<sub>6</sub>-C<sub>34</sub>-aryl,

for example

- diphenyl carbonate,  
 20 butylphenyl phenyl carbonate, di-butylphenyl carbonate,  
 isobutylphenyl phenyl carbonate, di-isobutylphenyl carbonate,  
 tert-butylphenyl phenyl carbonate, di-tert-butylphenyl carbonate,  
 n-pentylphenyl phenyl carbonate, di-(n-pentylphenyl) carbonate,

n-hexylphenyl phenyl carbonate, di-(n-hexylphenyl) carbonate,  
 cyclohexylphenyl phenyl carbonate, dicyclohexylphenyl carbonate,  
 phenylphenol phenyl carbonate, di-phenylphenol carbonate,  
 isooctylphenyl phenyl carbonate, di-isooctylphenyl carbonate,  
 5 n-nonylphenyl phenyl carbonate, di-(n-nonylphenyl) carbonate,  
 cumylphenyl phenyl carbonate, di-cumylphenyl carbonate,  
 naphthylphenyl phenyl carbonate, di-naphthylphenyl carbonate,  
 di-tert-butylphenyl phenyl carbonate, di-(di-tert-butylphenyl) carbonate,  
 dicumylphenyl phenyl carbonate, di-(dicumylphenyl) carbonate,  
 10 4-phenoxyphenyl phenyl carbonate, di-(4-phenoxyphenyl) carbonate,  
 3-pentadecylphenyl phenyl carbonate, di-(3-pentadecylphenyl) carbonate,  
 tritylphenyl phenyl carbonate, di-tritylphenyl carbonate,

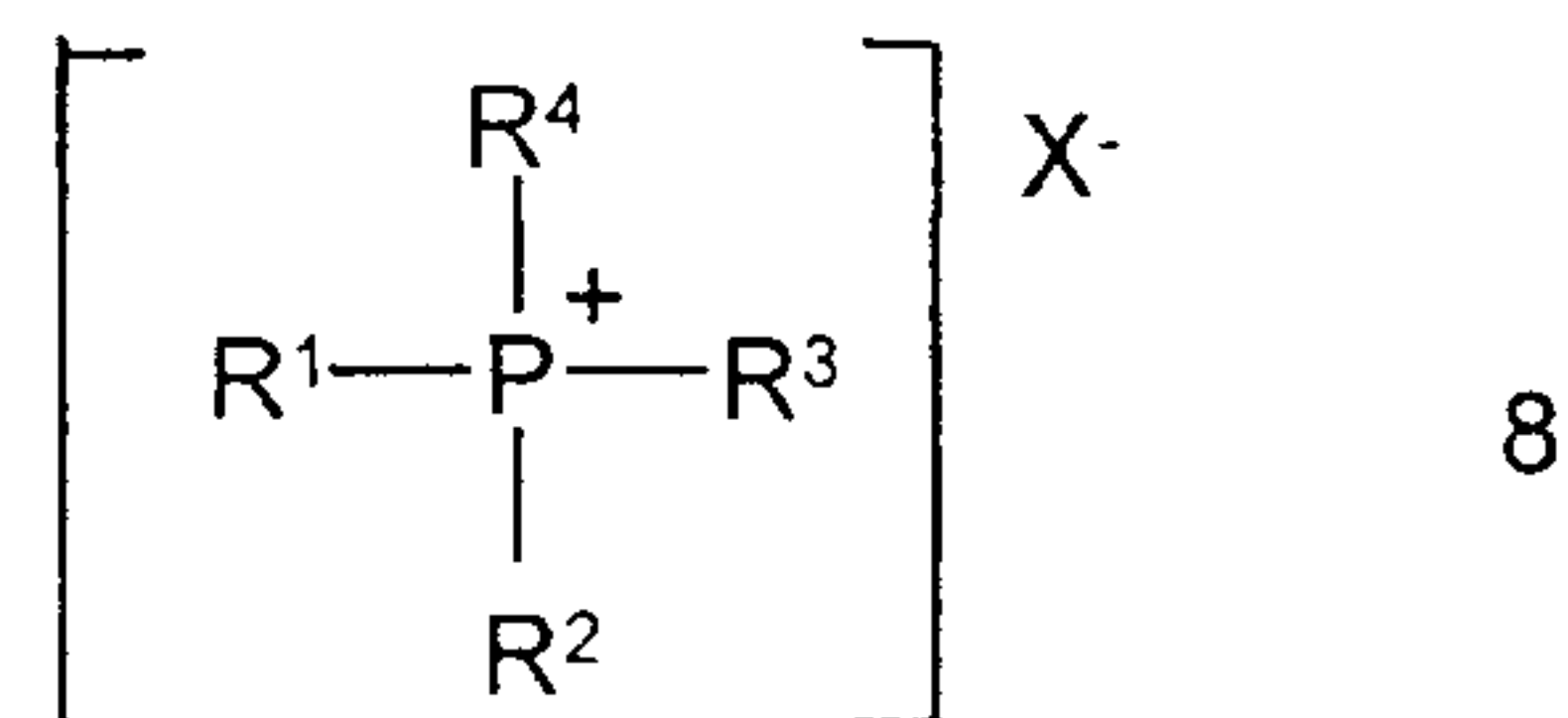
preferably  
 15 diphenyl carbonate,  
 tert-butylphenyl phenyl carbonate, di-tert-butylphenyl carbonate,  
 phenylphenol phenyl carbonate, di-phenylphenol carbonate,  
 cumylphenyl phenyl carbonate, di-cumylphenyl carbonate,  
 20 particularly preferably diphenyl carbonate.

Mixtures of the carbonic acid diesters mentioned can also be employed.

25 The content of carbonic acid ester is 100 to 130 mol%, preferably 103 to 120 mol%,  
 particularly preferably 103 to 109 mol%, based on the dihydroxy compound.

Catalysts in the context of the invention which are employed in the melt  
 transesterification process are basic catalysts as described in the literature  
 30 mentioned, such as, for example, alkali and alkaline earth metal hydroxides and  
 oxides, and also ammonium or phosphonium salts, called onium salts in the

following. In this context, onium salts, particularly preferably phosphonium salts, are preferably employed. Phosphonium salts in the context of the invention are those of the formula (8)



5 wherein

$\text{R}^{1-4}$  can be the same or different  $\text{C}_1$ - $\text{C}_{10}$ -alkyls,  $\text{C}_6$ - $\text{C}_{10}$ -aryls,  $\text{C}_7$ - $\text{C}_{10}$ -aralkyls or  $\text{C}_5$ - $\text{C}_6$ -cycloalkyls, preferably methyl or  $\text{C}_6$ - $\text{C}_{14}$ -aryls, particularly preferably methyl or phenyl, and

10

$\text{X}^-$  can be an anion, such as hydroxide, sulfate, hydrogen sulfate, bicarbonate, carbonate, a halide, preferably chloride, or an alcoholate of the formula  $\text{OR}$ , wherein  $\text{R}$  can be  $\text{C}_6$ - $\text{C}_{14}$ -aryl or  $\text{C}_7$ - $\text{C}_{12}$ -aralkyl, preferably phenyl.

15 Preferred catalysts are

tetraphenylphosphonium chloride,

tetraphenylphosphonium hydroxide,

tetraphenylphosphonium phenolate,

20

particularly preferably tetraphenylphosphonium phenolate.

The catalysts are preferably employed in amounts of from  $10^{-8}$  to  $10^{-3}$  mol, based on one mol of bisphenol, particularly preferably in amounts of from  $10^{-7}$  to  $10^{-4}$  mol.

25

Further catalysts can be used, alone or optionally in addition to the onium salt, in order to increase the speed of the polymerization. These include salts of alkali metals and alkaline earth metals, such as hydroxides, alkoxides and aryloxides of

lithium, sodium and potassium, preferably hydroxide, alkoxide or aryloxide salts of sodium. Sodium hydroxide and sodium phenolate are most preferred. The amounts of the cocatalyst can be in the range of from 1 to 200 ppb, preferably 5 to 150 ppb and most preferably 10 to 125 ppb, in each case calculated as sodium.

5

The transesterification reaction of the aromatic dihydroxy compound and the carbonic acid diester in the melt is preferably carried out in two stages. In the first stage, melting of the aromatic dihydroxy compound and the carbonic acid diester takes place at temperatures of from 80 to 250 °C, preferably 100 to 230 °C, particularly preferably 120 to 190 °C, under normal pressure in the course of 0 to 5 hours, preferably 0.25 to 3 hours. After addition of the catalyst, the oligocarbonate is prepared from the aromatic dihydroxy compound and the carbonic acid diester by distilling off the monophenol by applying a vacuum (down to 2 mm Hg) and increasing the temperature (up to 260 °C). The main amount of vapours from the process are obtained here. The oligocarbonate prepared in this way has a weight-average molar mass  $M_w$  (determined by measurement of the rel. solution viscosity in methylene chloride or in mixtures of equal amounts by weight of phenol/o-dichlorobenzene calibrated by light scattering) in the range of from 2,000 g/mol to 18,000 g/mol, preferably from 4,000 g/mol to 15,000 g/mol.

20

In the second stage, the polycarbonate is prepared in the polycondensation by further increasing the temperature to 250 to 320 °C, preferably 270 to 295 °C, under a pressure of <2 mm Hg. The remainder of vapours are removed from the process here.

25

The catalysts can also be employed in combination (two or more) with one another.

If alkali/alkaline earth metal catalysts are employed, it may be advantageous to add the alkali/alkaline earth metal catalysts at a later point in time (e.g. after the oligocarbonate synthesis, during the polycondensation in the second stage).

30

In the context of the process according to the invention, the reaction of the aromatic dihydroxy compound and the carbonic acid diester to give the polycarbonate can be carried out discontinuously or preferably continuously, for example in stirred tanks, thin film evaporators, falling film evaporators, stirred tank cascades, extruders, kneaders, simple disc reactors and high-viscosity disc reactors.

Analogously to the phase interface process, branched poly- or copolycarbonates can be prepared by using polyfunctional compounds.

Embodiments which utilize the parameters, compounds, definitions and explanations mentioned under preferred, particularly preferred or very particularly preferred or preferably etc. are preferred, particularly preferred or very particularly preferred.

However, the definitions, parameters, compounds and explanations mentioned generally or mentioned in preferred ranges in the description can also be combined with one another as desired, that is to say between the particular ranges and preferred ranges.

The polycarbonates and copolycarbonates according to the invention can be worked up and processed to any desired shaped articles in a known manner, for example by extrusion, injection moulding or extrusion blow moulding.

Other aromatic polycarbonates and/or other aromatic polyester carbonates and/or other aromatic polyesters can also be admixed to the polycarbonates and copolycarbonates according to the invention in a known manner, for example by compounding.

The conventional additives for these thermoplastics, such as fillers, UV stabilizers, heat stabilizers, antistatics and pigments, can also be added in the conventional amounts to the polycarbonates and copolycarbonates according to the invention; the mould release properties, the flow properties and/or the flame resistance can

optionally also be improved by addition of external mould release agents, flow agents and/or flameproofing agents (e.g. alkyl and aryl phosphites and phosphates, alkyl- and arylphosphanes and low molecular weight carboxylic acid alkyl and aryl esters, halogen compounds, salts, chalk, quartz flour, glass fibres and carbon fibres, pigments and a combination thereof. Such compounds are described e.g. in WO 99/55772, p. 15 - 25, and in the corresponding chapters of the "Plastics Additives Handbook", ed. Hans Zweifel, 5th edition 2000, Hanser Publishers, Munich).

The polycarbonates and copolycarbonates according to the invention, optionally in a mixture with other thermoplastics, such as, for example, graft polymers based on acrylonitrile/butadiene/styrene or graft copolymers based on acrylate rubber (see, for example, the graft polymers described in EP-A 640 655) and/or conventional additives, when processed to any desired shaped articles/extrudates, can be employed in all instances where polycarbonates, polyester carbonates and polyesters which are already known are employed. Further possible uses of the polycarbonates according to the invention are:

1. Safety panes, which as is known are required in many areas of buildings, vehicles and aircraft, and also as visors of helmets.
2. Production of films, in particular films for skis.
3. Production of blow-moulded articles (see also US Patent 2 964 794), for example 1 to 5 gallon water bottles.
4. Production of transparent sheets, in particular hollow chamber sheets, for example for covering buildings such as railway stations, greenhouses and lighting installations.
5. Production of optical data storage media.

6. For production of traffic light housings or traffic signs.
7. For production of foams (see, for example, DE-B 1 031 507).
- 5 8. For production of threads and wires (see, for example, DE-B 1 137 167 and DE-A 1 785 137).
9. As translucent plastics with a content of glass fibres for lighting purposes (see, for example, DE-A 1 554 020).
- 10 10. As translucent plastics with a content of barium sulfate, titanium dioxide and/or zirconium oxide or organic polymeric acrylate rubbers (EP-A 0 634 445, EP-A 269324) for the production of transparent and light-scattering mouldings.
- 15 11. For the production of precision injection mouldings, such as, for example, lens holders. Polycarbonates with a content of glass fibres which optionally additionally contain about 1 to 10 wt.% of MoS<sub>2</sub>, based on the total weight, are used for this purpose.
- 20 12. For the production of optical equipment components, in particular lenses for photographic and film cameras (see, for example, DE-A 2 701 173).
- 25 13. As light transmission carriers, in particular as light conductor cables (EP-A 0 089 801).
14. As electrical insulating materials for electrical conductors and for plug housings and plug connectors.
- 30 15. Production of mobile telephone housings with improved resistance to perfume, shaving lotion and skin perspiration.

16. Network interface devices.
17. As a carrier material for organic photoconductors.
- 5 18. For the production of lamps, e.g. searchlights, as so-called headlamps, light-diffusing panes or internal lenses, as well as long-distance lamps.
19. For medical uses, such as e.g. oxygenators, dialyzers.
- 10 20. For foodstuffs uses, such as e.g. bottles, utensils and chocolate moulds.
21. For uses in the automobile field where contact with fuels and lubricants may occur, such as, for example, bumpers, optionally in the form of suitable blends with ABS or suitable rubbers.
- 15 22. For sports articles, such as e.g. slalom poles or ski boot buckles.
23. For household articles, such as e.g. kitchen sinks and letterbox housings.
- 20 24. For housings, such as e.g. electrical distribution boxes
25. Housings for electric toothbrushes and hairdryer housings.
- 25 26. Transparent washing machine portholes with improved resistance to the wash solution.
27. Safety glasses, visors or optical corrective glasses.
- 30 28. Lamp covers for kitchen equipment with improved resistance to kitchen fumes, in particular oil vapours.

29. Packaging films for medicaments.

30. Chip boxes and chip supports.

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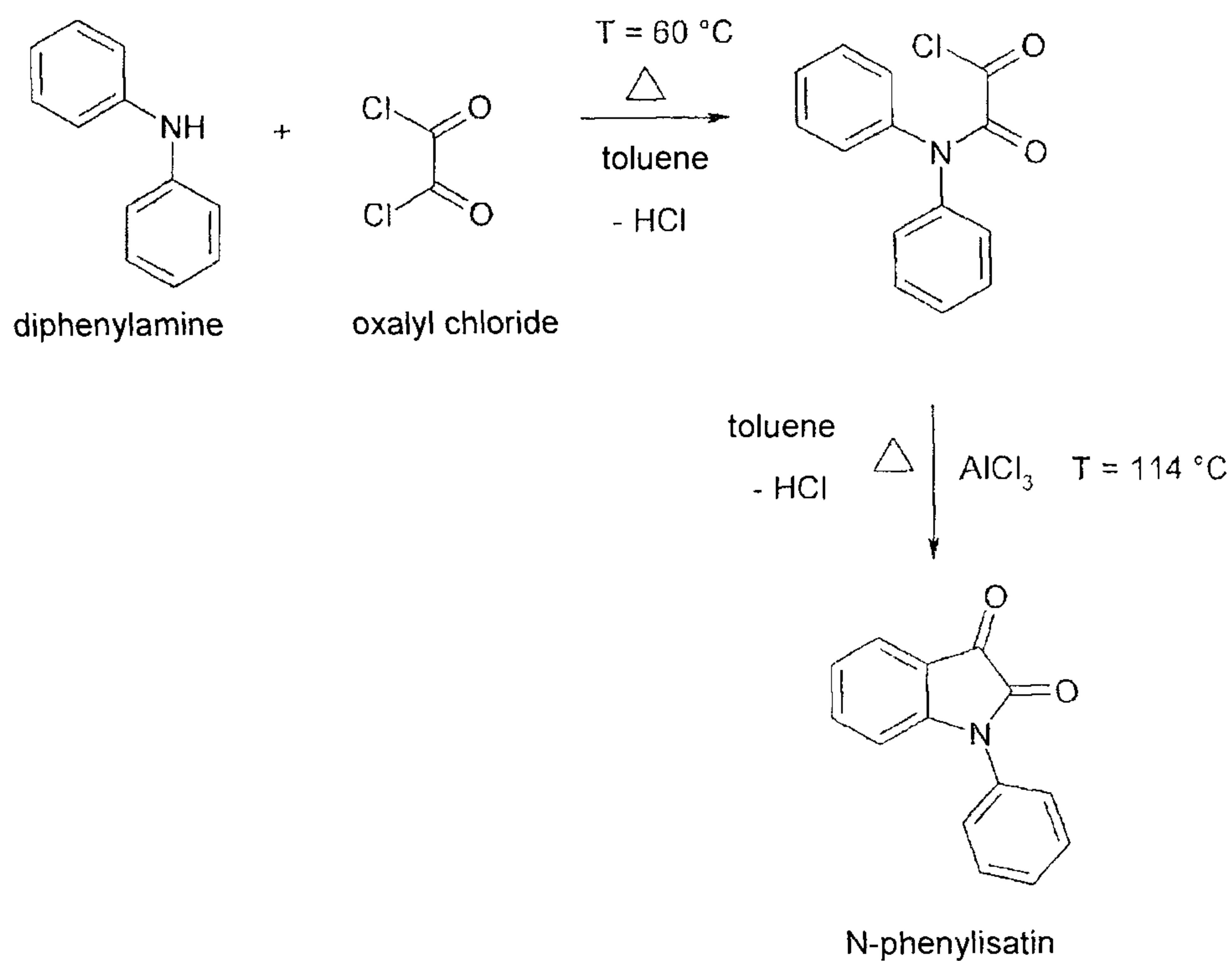
31. For other uses, such as e.g. fattening stable doors or animal cages.

32. Safety helmets

10 This Application likewise provides the shaped articles and mouldings and extrudates from the polymers according to the invention.

**Examples****A) Preparation of bisphenol of the formula (1)**5 **Example 1:**

Preparation of N-phenylisatin



10

660 g (5.20 mol) oxalic acid dichloride, dissolved in 1,600 ml anhydrous toluene, are initially introduced into a previously heated apparatus at room temperature.

15

798 g (4.72 mol) diphenylamine, likewise dissolved in 1,200 ml anhydrous toluene, are pumped in by means of a Telab pump (setting: 10 strokes/minute at 30 %) in the course of 1.5 hours under intensive stirring. During this procedure, the reaction

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batch is thermostatically controlled at 45 °C. The maximum temperature reached due to the heat of reaction is 50 °C.

5 Directly after the diphenylamine solution has been pumped in, the progress of the reaction is checked by means of gas chromatography (GC) at the intermediate stage before the cyclization (molecular weight 259.69 g/mol; conversion 98.4 area%; determination of the retention time by prior GC-MS). To carry out the cyclization, 15 g of dry aluminium chloride are added. The mixture is then heated up to the reflux temperature. The temperature is maintained for 3 hours, the HCl gas formed  
10 being passed into an alkaline destruction reservoir.

After the end of the reaction, a reaction progress of greater than 90 area% of the desired end product N-phenylisatin (molecular weight 223.23 g/mol) is determined by means of GC.

15

Working up:

The reaction mixture is precipitated in water, the crude product is filtered off with suction and washed 3 times with distilled water, filtered off under high suction again  
20 and then dried at 70 °C in a vacuum drying cabinet.

Yield:

977.1 g of an orange-coloured solid (92.7 % of theory) having a melting point of  
25 138 °C are obtained (GC purity of 98.7 %).

Analysis:

- GC-MS: molecular weight 223 g/mol

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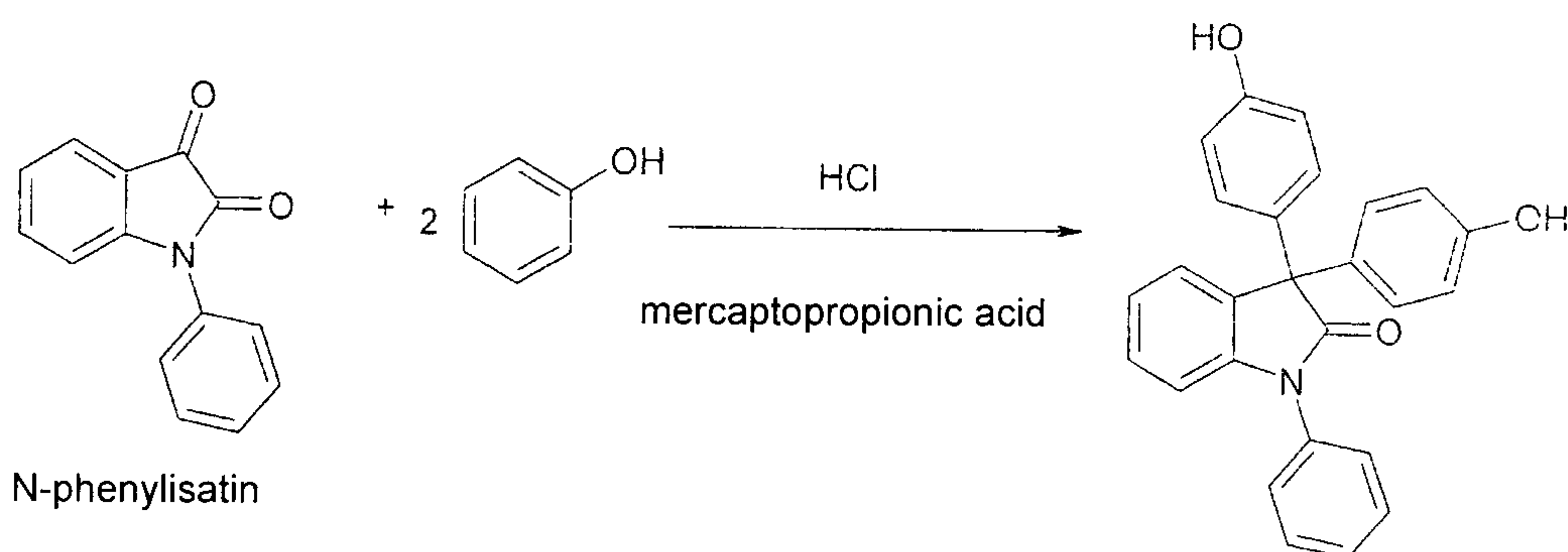
-  $^1\text{H-NMR}$  (400 MHz, TMS  $\text{CDCl}_3$ )  $\delta$ =7.71-7.69 (d, 1H), 7.58-7.52 (m, 3H), 7.47-7.41 (m, 3H), 7.19-7.15 (t, 1H), 6.91-6.88 (d, 1H).

### Example 2

5

### Bisphenol of the formula (1)

Preparation of 3,3-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-2-one



10

1,400 g (6.27 mol) N-phenylisatin from Example 1, 3,541 g (37.6 mol) molten, freshly distilled phenol and 7 g (0.66 mol) 3-mercaptopropionic acid (cocatalyst) are initially introduced into the apparatus, which has been rendered inert, and are heated to 40 - 45 °C.

15

Hydrogen chloride gas is now cautiously passed into this red-brown homogeneous solution for 25 minutes, with moderate stirring, during which the temperature rises to 67 °C.

20

The dark brown batch is then cooled to room temperature and the beige suspension formed is filtered with suction.

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Analysis of the product formed:

1st GC control:

5 4.0 area% phenol

14.2 area% of a product isomer 2,2-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-2-one

10 81.1 area% of the product 3,3-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-2-one

Washing the crude product 8 times with 1 litre of methylene chloride each time leads to the following product:

15 0.03 area% phenol

2.5 area% of the isomer 2,2-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-3-one

97.2 area% of the product 3,3-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-2-one

20 Yield after drying:

830 g of a slightly yellowish solid (33.6 % of theory).

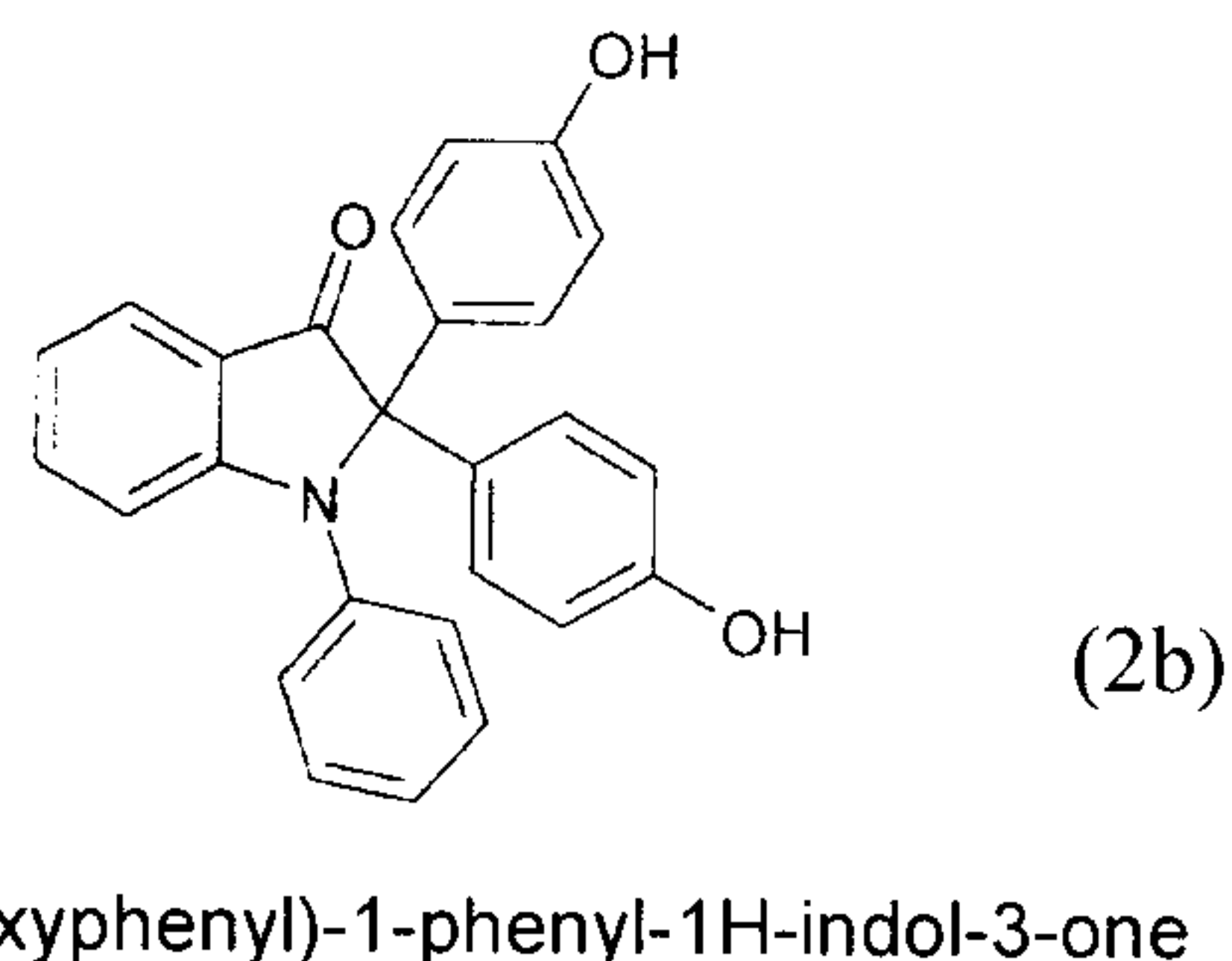
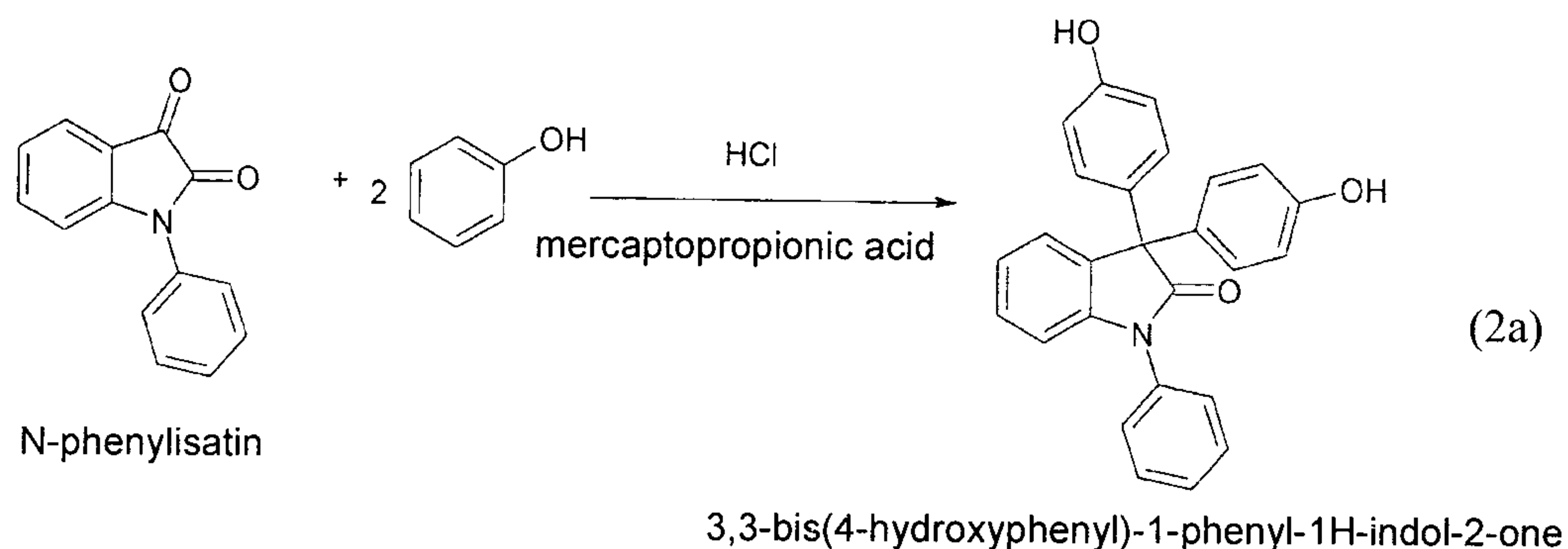
Analysis:

25 - GC-MS: in each case molecular weight 537 g/mol after derivatization as a trimethylsilyl adduct

30 - <sup>1</sup>H-NMR (400 MHz, TMS, DMSO) δ=9.47 (s, 2H), 7.60-7.57 (t, 2H), 7.50-7.45 (m, 3H), 7.30-7.35 (d, 1H), 7.28-7.20 (t, 1H), 7.15-7.10 (t, 1H), 7.09-7.04 (d, 4H), 6.81-6.79 (d, 1H), 6.77-6.71 (d, 4H).

\*) Isomer reaction:

5 The compound 2,2-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-3-one is formed as a secondary component by condensation of N-phenylisatin with phenol.

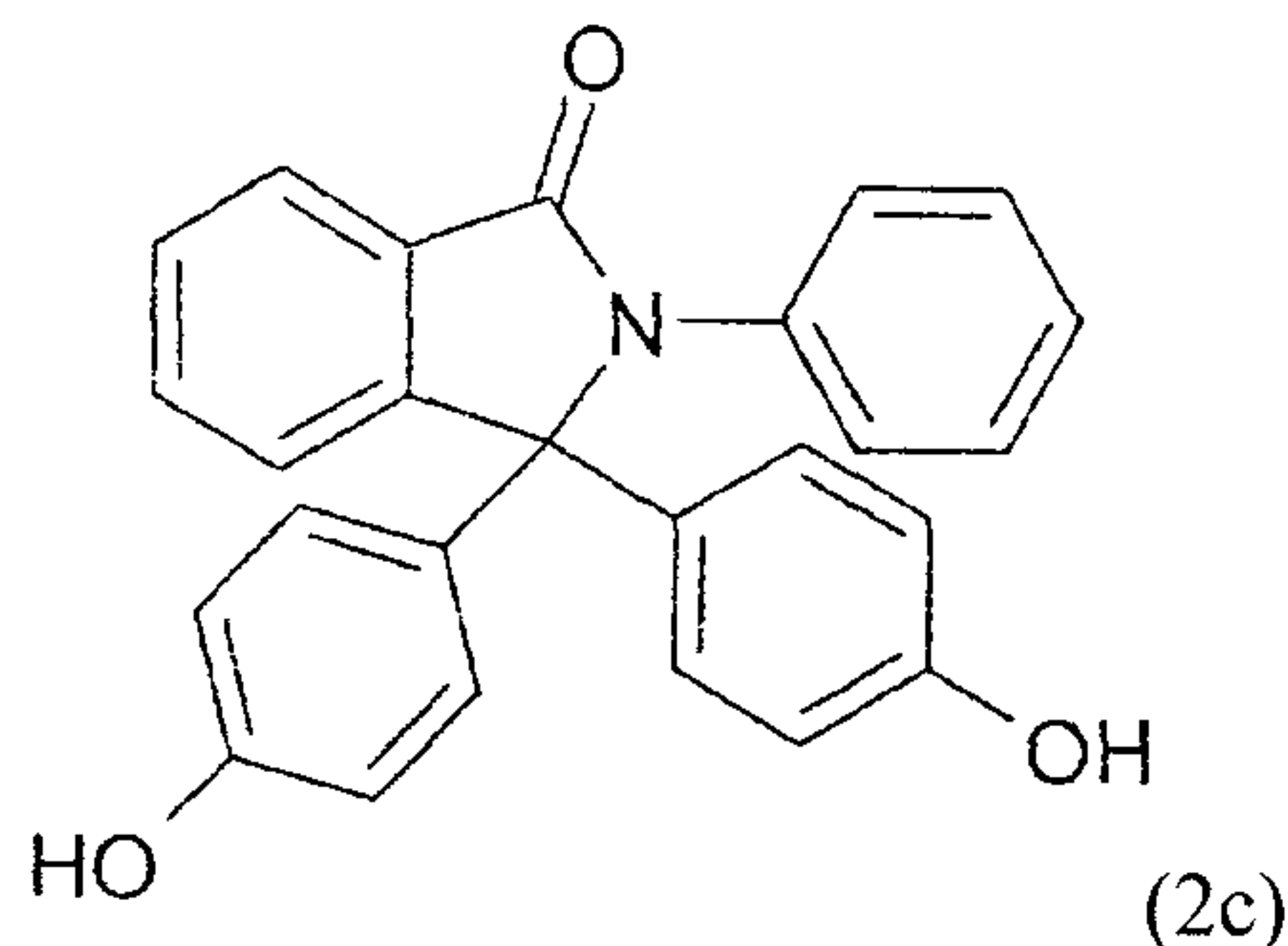


### Analysis

10 The analytical determination of the structure of the product obtained (Example 2) after preparation of the sample (conversion into the trimethylsilyl derivative) was carried out by means of gas chromatography-mass spectrometry (GC-MS).

15 The compound (2a) as the trimethylsilyl derivative has a molecular weight of 537 g/mol. In the GC a further peak is found at a shorter retention time, which according to analysis by means of gas spectrometry likewise has, as the trimethylsilyl derivative, the molecular weight of 537 g/mol. This isomer has the structure according to Example (2b). Furthermore, it was possible to demonstrate by

different fragmentation in the mass spectrum that this structure is unambiguously the structure (2b) and not the structure of the bisphenol of the formula (2c).



5 **B) Preparation of polycarbonate**

**Example 3**

10 Preparation of a copolycarbonate (50/50 mol%) from bisphenol A (BPA) and the bisphenol according to the invention according to Example 2 (3,3-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-2-one (97.2 % according to GC), 2,2-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-3-one (2.5 % according to GC)).

15 In order to obtain sufficient amounts of bisphenol of the example for a continuous process, the batch of Example 2 was repeated several times.

A copolycarbonate was obtained by the phase interface process by means of a laboratory continuous unit. The following synthesis conditions and reaction parameters/meterings (in each case the amount per hour) were maintained:

20

- 15 % strength sodium bisphenolate solution containing a mixture of bisphenol A and the isomer mixture from Example 2 (50/50 mol%)
- 2.1 mol sodium hydroxide solution per mol bisphenol in the sodium bisphenolate solution

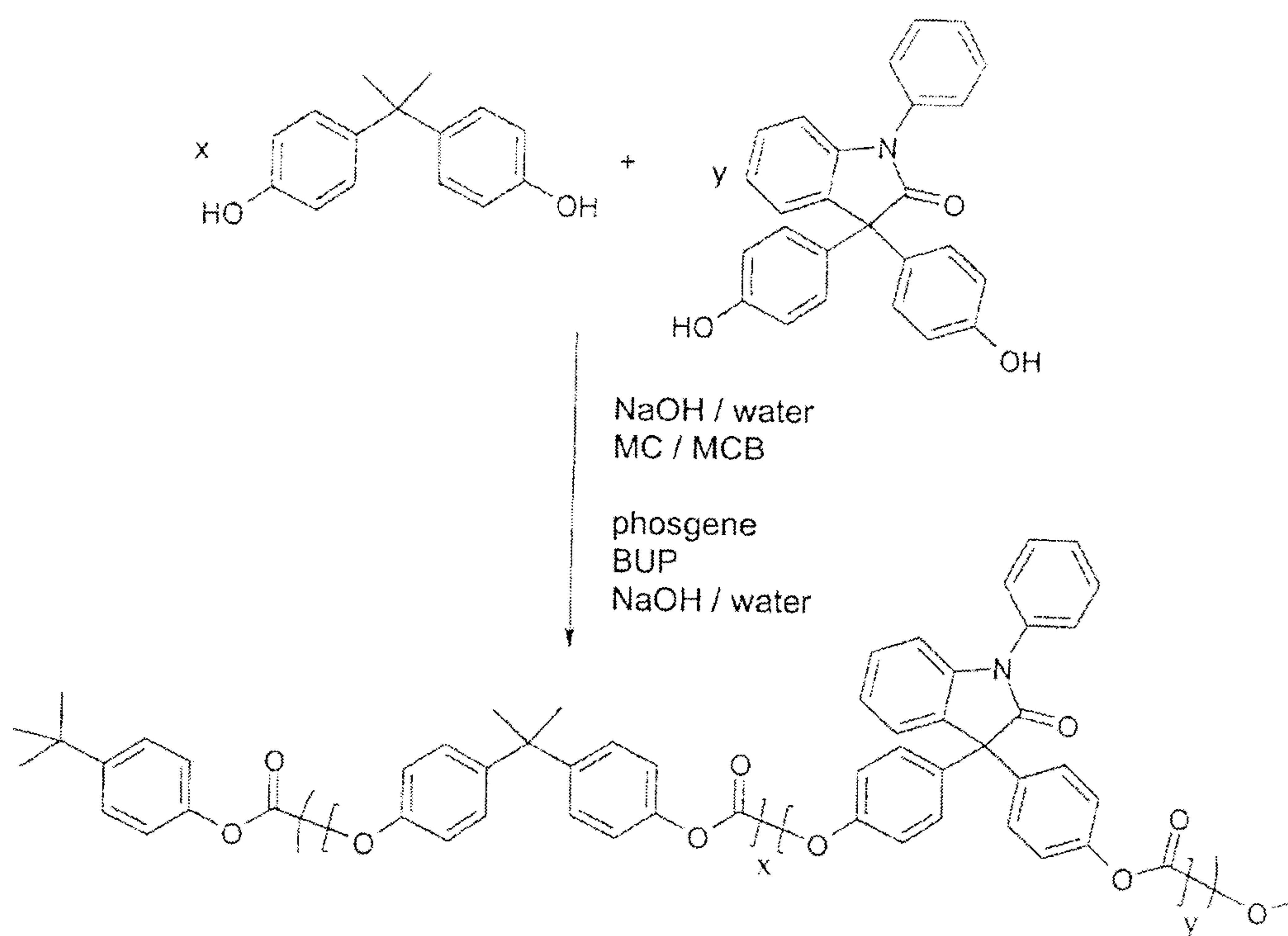
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- 1.40 mol phosgene per mol bisphenol (or 1.382 mol phosgene per mol bisphenol + 0.5 mol chain terminator)
- temperature 30 °C during the phosgenation
- p-tert-butylphenol (BUP) as the chain terminator
- 3.6 mol% chain terminator per mol bisphenol
- 1 mol% N-ethylpiperidine (EPP) per mol bisphenol as a catalyst (7.4 % strength solution in the solvent mixture methylene chloride/chlorobenzene (50/50 wt.%))
- 15.0 % strength polycarbonate solution in the solvent mixture methylene chloride/chlorobenzene (50/50) as the desired organic phase
- weight of the copolycarbonate formed 156 g/h

The following amounts per hour are reacted in this context:

943.3 g of a 15 % strength solution consisting of 52.0 g bisphenol A, 89.5 g bisphenol from Example 5, dissolved in an alkaline aqueous phase of 720 g water and 81.8 g concentrated sodium hydroxide solution (46.7 % strength), are combined together with 736.9 g of a solvent mixture consisting of methylene chloride/chlorobenzene (50/50) which contain 63.0 g phosgene. To regulate the molecular weight, after the phosgenation 2.461 g BUP in 140.6 g of the solvent mixture methylene chloride/chlorobenzene (50/50) are added. To maintain the alkaline pH of approx. 12 - 13, 66.0 g concentrated sodium hydroxide solution (46.7 % strength) are moreover metered in. At the rear end of the dwell zone of the apparatus, 0.515 g EPP, dissolved in 6.44 g of the solvent mixture methylene chloride/chlorobenzene (50/50), is added.

**Reaction equation**

$$x = 0.5$$

$$y = 0.5$$

Due to the isomer 2,2-bis(4-hydroxyphenyl)-1-phenyl-1H-indol-3-one formed during the preparation of Example 2, the corresponding content of the isomer is contained in  $y = 0.5$ .

10

After the organic copolycarbonate solution obtained has been washed, the solvent mixture is evaporated off in vacuo, a solid thereby being obtained, which is comminuted and homogenized.

15

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Analysis

Relative solution viscosity in methylene chloride at 25 °C (concentration 5 g/l):  
1.168

5

Gel permeation chromatography (GPC, calibration by means of BPA polycarbonate,  
UV detector 254 nm):

$M_n = 8,417 \text{ g/mol}$

10

$M_w = 18,666 \text{ g/mol}$

$D = 2.22$  (polydispersity)

15 Oligomer content in the range of 300 - 1,500 g/mol: 2.08 %

Glass transition temperature (DSC after 2nd heating up of 50 - 280 °C, 20 °C/min  
heating up rate): 210 °C

20 **Examples 4 - 8**

In order to obtain sufficient amounts of polycarbonate in a laboratory continuous  
unit (limited capacity), the process according to Example 3 was carried out several  
times. The polycarbonates obtained therefrom are characterized as follows:

25

**Example 4**

Relative solution viscosity in methylene chloride at 25 °C (concentration 5 g/l):  
1.202

30

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Gel permeation chromatography (GPC, calibration by means of BPA polycarbonate, UV detector 254 nm):

Mn = 10,497 g/mol

5

Mw = 22,972 g/mol

D = 2.19

10 Oligomer content in the range of 300 - 1,500 g/mol: 1.41 %

Glass transition temperature (DSC after 2nd heating up of 50 - 280 °C, 20 °C/min heating up rate): 210 °C

15 **Example 5**

Relative solution viscosity in methylene chloride at 25 °C (concentration 5 g/l): 1.215

20 Gel permeation chromatography (GPC, calibration by means of BPA polycarbonate, UV detector 254 nm):

Mn = 10,052 g/mol

25 Mw = 24,666 g/mol

D = 2.23

Oligomer content in the range of 300 - 1,500 g/mol: 1.41 %

30

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Glass transition temperature (DSC after 2nd heating up of 50 - 280 °C, 20 °C/min heating up rate): 212 °C

**Example 6**

5

Relative solution viscosity in methylene chloride (concentration 5 g/l):

1.162 / 1.162 (duplicate determination)

10 Gel permeation chromatography (GPC, calibration by means of BPA polycarbonate, UV detector 254 nm):

Mn = 8,280 g/mol

15 Mw = 16,777 g/mol

D = 2.03

Oligomer content in the range of 300 - 1,500 g/mol: 1.82 %

20

Glass transition temperature (DSC after 2nd heating up of 50 - 280 °C, 20 °C/min heating up rate): 207 °C

25 In order to obtain sufficient amounts of polycarbonate in a laboratory continuous unit (limited capacity), the process according to Example 3 was carried out several times. The polycarbonates obtained therefrom are characterized as follows:

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**Example 7**

Relative solution viscosity in methylene chloride (concentration 5 g/l):

5      1.165 / 1.166 (duplicate determination)

Gel permeation chromatography (GPC, calibration by means of BPA polycarbonate, UV detector 254 nm):

10       $M_n = 8,633 \text{ g/mol}$

$M_w = 17,407 \text{ g/mol}$

$D = 2.02$

15

Oligomer content in the range of 300 - 1,500 g/mol: 1.65 %

Glass transition temperature (DSC after 2nd heating up of 50 - 280 °C, 20 °C/min heating up rate): 204 °C

20

**Example 8**

Relative solution viscosity in methylene chloride (concentration 5 g/l):

25      1.166 / 1.165 (duplicate determination)

Gel permeation chromatography (GPC, calibration by means of BPA polycarbonate, UV detector 254 nm):

30       $M_n = 8,251 \text{ g/mol}$

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 $M_w = 17,023 \text{ g/mol}$  $D = 2.06$ 

5 Oligomer content in the range of 300 - 1,500 g/mol: 1.86 %

Glass transition temperature (DSC after 2nd heating up of 50 - 280 °C, 20 °C/min heating up rate): 204 °C

10 **Example 9**

All the copolycarbonate fractions from Example 3-8 are combined. The copolycarbonate obtained in this way is characterized as follows:

15 Relative solution viscosity in methylene chloride (concentration 5 g/l): 1.174

Gel permeation chromatography (GPC, calibration by means of BPA polycarbonate, UV detector 254 nm):

20  $M_n = 9,004 \text{ g/mol}$

 $M_w = 18,029 \text{ g/mol}$  $D = 2.00$ 

25

Oligomer content in the range of 300 - 1,500 g/mol: 1.44 %

Glass transition temperature (DSC after 2nd heating up of 50 - 280 °C, 20 °C/min heating up rate): 207 °C

30

**C) Testing of the metal adhesion of the copolycarbonate according to Example 9**

5 The copolycarbonate according to Example 9 is extruded to granules and, after predrying at 130 °C for 4 hours, subsequently injection moulded to circular test specimens (diameter: 2 cm, thickness 3 mm). A layer of 200 nm aluminium is sputtered on to the test specimens obtained in this way. An adhesive tape type 3M 853 from 3M is applied to this metal layer. To test the metal adhesion, this adhesive tape is peeled off again immediately after application.

10

Compared with an analogously metallized specimen of injection-moulded copolycarbonate of 65 mol% bisphenol A and 35 mol% bisphenol TMC having a relative solution viscosity of 1.26, measured in methylene chloride at 25 °C and a concentration of 5 g/l, an improved adhesion of the aluminium to the copolycarbonate surface is found here.

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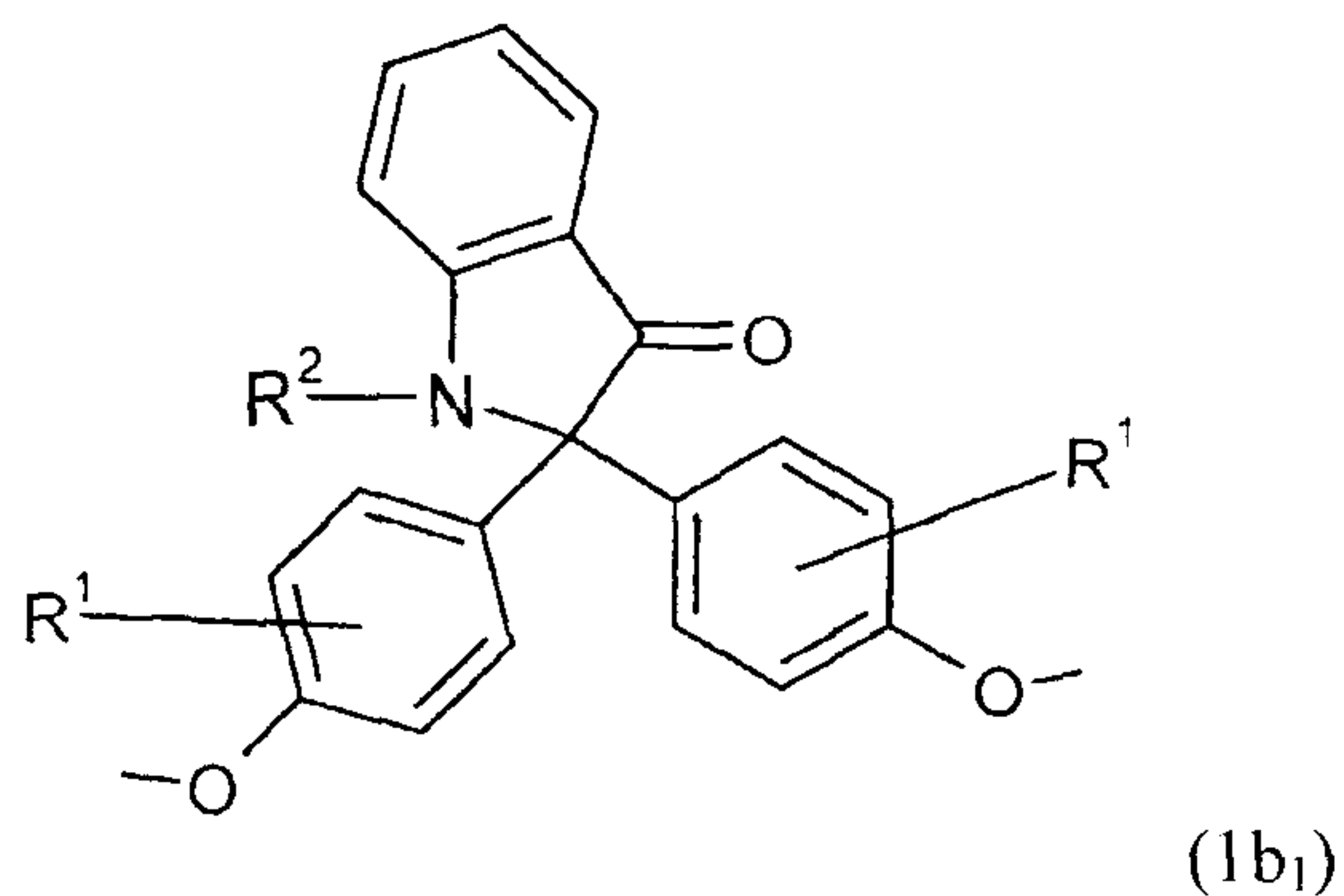
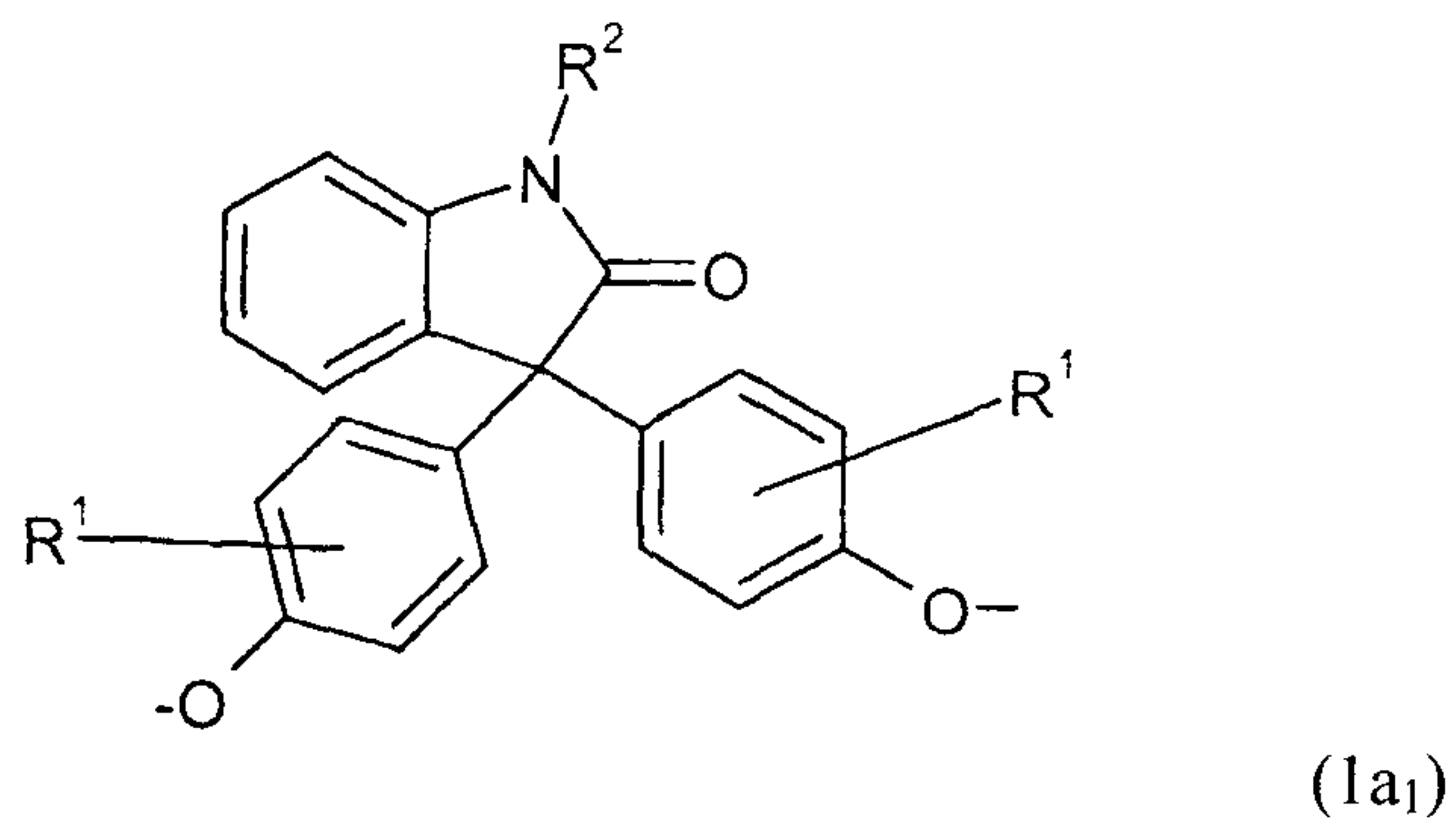
Test specimens according to the invention: after peeling off the adhesive tape, 19 % of the original aluminium area remains on the polycarbonate substrate

20 Comparison test specimens: On the comparison specimen, after peeling off the adhesive tape no residue at all of the aluminium sputtered on is to be detected. The aluminium deposit hangs completely on the adhesive tape.

**Patent claims**

1. (Co)polycarbonate containing bisphenols of the formulae (1a<sub>1</sub>), (1b<sub>1</sub>) (isomer mixture) as a recurring monomer unit

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in which

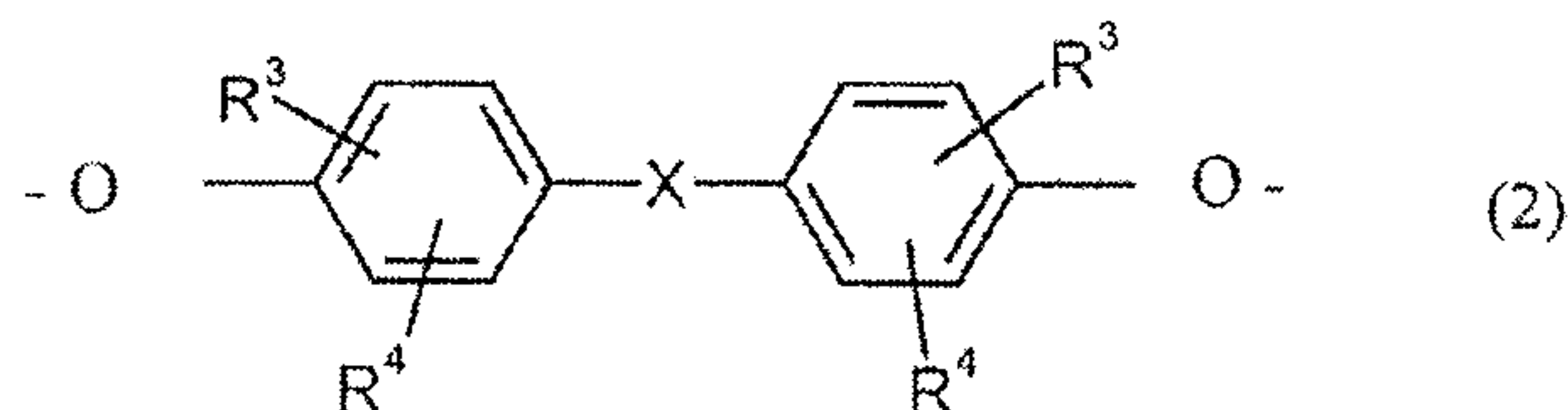
10            R<sup>1</sup>        independently of one another represents hydrogen or C<sub>1</sub>-C<sub>10</sub>-alkyl  
and

             R<sup>2</sup>        represents C<sub>1</sub>-C<sub>10</sub>-alkyl, or phenyl or benzyl in each case optionally  
substituted by hydrogen and/or C<sub>1</sub>-C<sub>10</sub>-alkyl.

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2. (Co)polycarbonate according to claim 1, containing up to 95 mol% (based on the amount of diphenols employed) of diphenols of the formula (2)

- 40 -



in which

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$R^3$  and  $R^4$  independently of one another represent hydrogen,  $C_1$ - $C_{18}$ -alkyl,  $C_1$ - $C_{18}$ -alkoxy, halogen or in each case optionally substituted aryl or aralkyl, and

10

X represents a single bond,  $-SO_2-$ ,  $-CO-$ ,  $-O-$ ,  $-S-$ ,  $C_1$ - to  $C_6$ -alkylene,  $C_2$ - to  $C_5$ -alkylidene or  $C_5$ - to  $C_6$ -cycloalkylidene, which can be substituted by  $C_1$ - to  $C_6$ -alkyl, or  $C_6$ - to  $C_{12}$ -arylene, which can optionally be fused with further aromatic rings containing hetero atoms.

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3. (Co)polycarbonate according to claim 1, containing up to 80 mol% (based on the amount of diphenols employed) of diphenols of the formula (2).

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4. (Co)polycarbonate according to claim 3, containing 40 - 60 mol% of diphenol of the formula (1) and 60 to 40 mol% of diphenol of the formula (2).

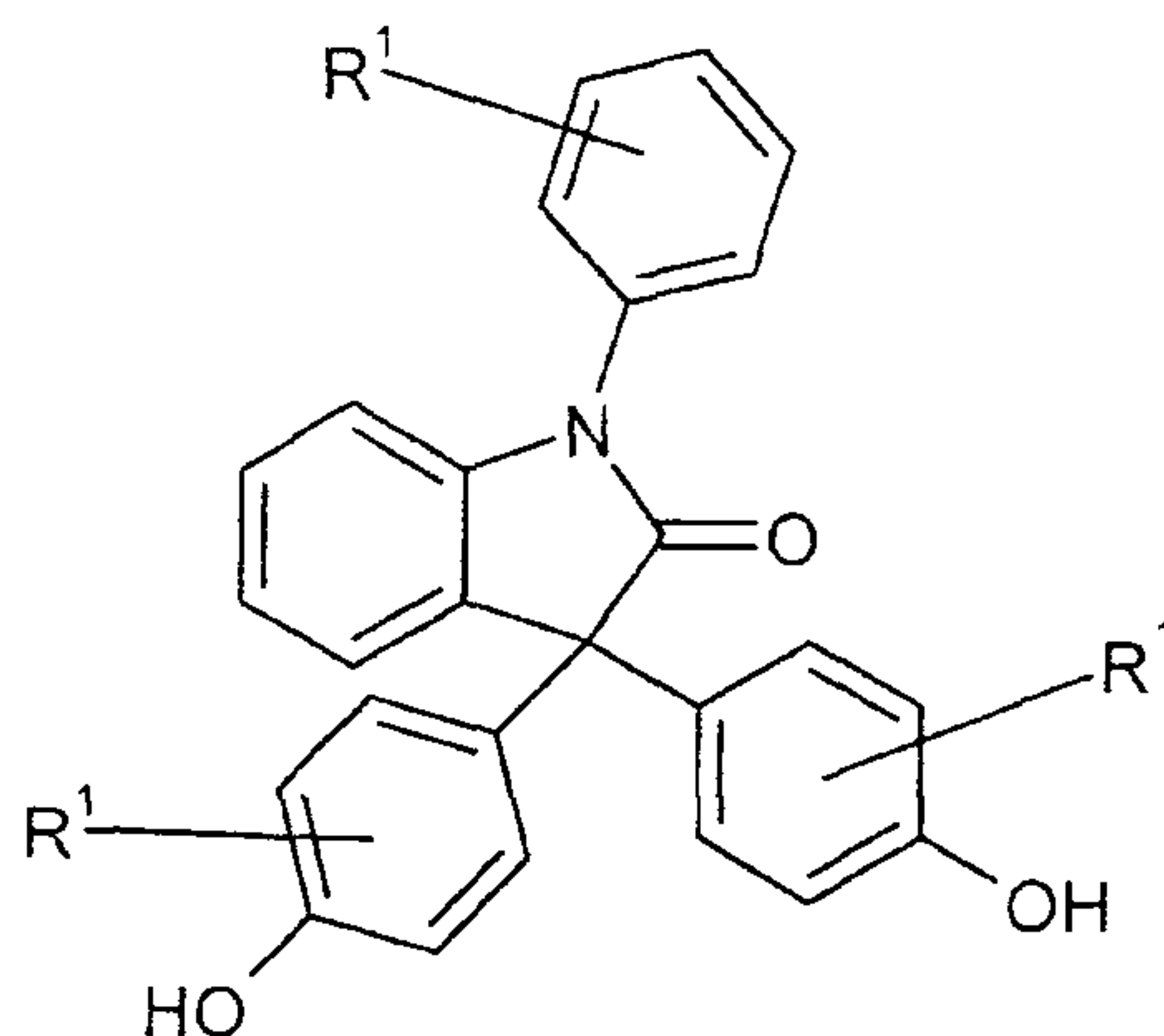
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5. (Co)polycarbonate according to claim 3, containing 45 - 55 mol% of diphenol of the formula (1) and 55 to 45 mol% of diphenol of the formula (2).

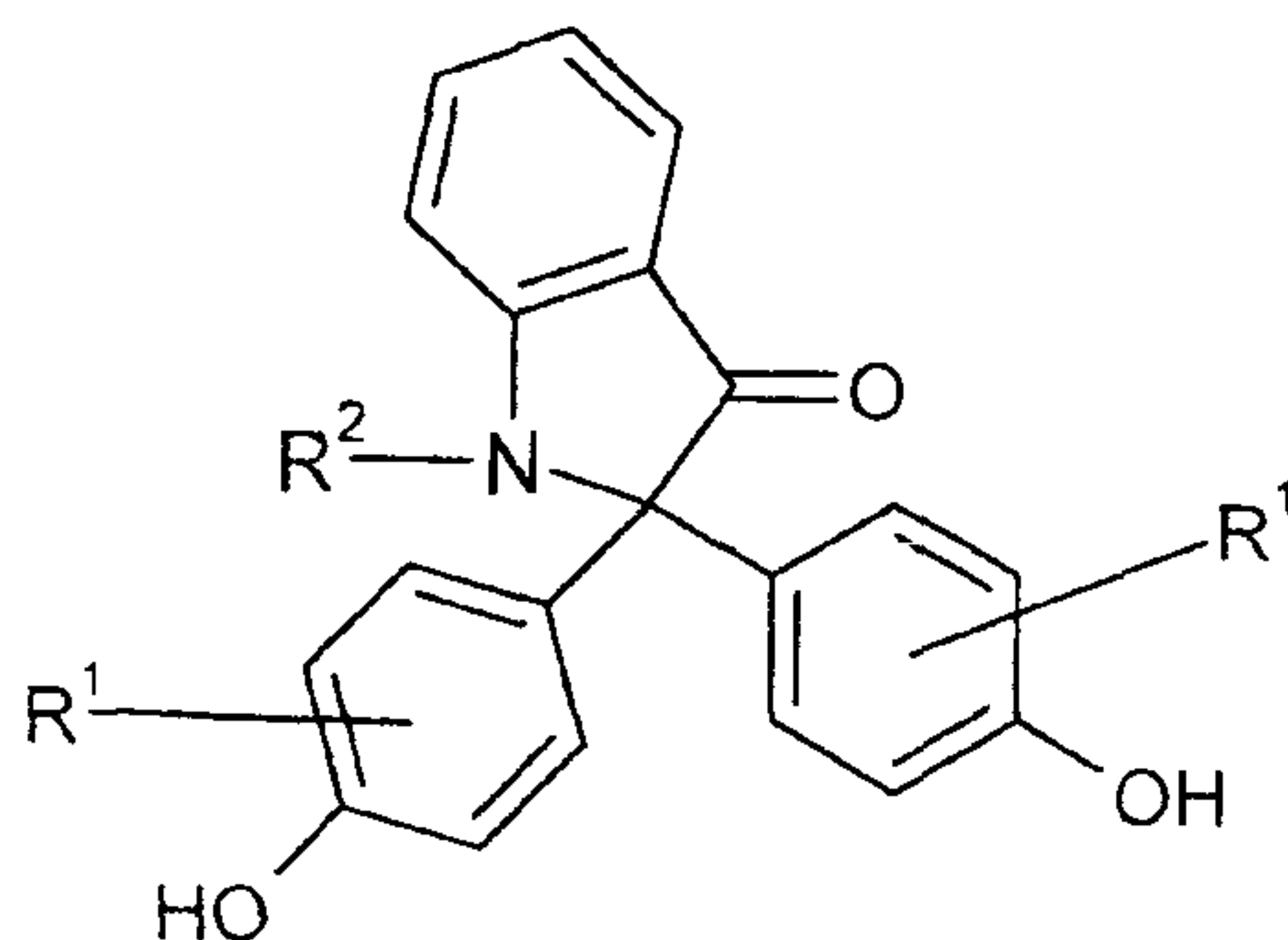
6. (Co)polycarbonate according to claim 1, wherein in the formulae (1a<sub>1</sub>) and (1b<sub>1</sub>)  $R^1$  denotes hydrogen and  $R^2$  denotes phenyl.

7. (Co)polycarbonate according to claim 2, wherein diphenols of the formula (2) are chosen from at least one from the group consisting of bisphenol A, 4,4'-dihydroxybiphenyl, bisphenol M and bisphenol TMC.
8. Use of (co)polycarbonates according to claim 1 for the production of mouldings.
9. Mouldings obtainable from (co)polycarbonates according to claim 1.
10. Products from injection moulding or extrusion processes, such as e.g. automobile screens, optical data storage media, sheets, films and bottles, comprising (co)polycarbonates according to claim 1.
11. Metallized mouldings comprising (co)polycarbonates according to claim 1.
12. Blends of the (co)polycarbonates according to claim 1 with thermoplastic polymers.
13. Process for the preparation of (co)polycarbonates according to claim 1 by the phase interface process, characterized in that compounds of the formula (1a) are employed as the bisphenol.
14. Compound of the formulae (1a) and (1b)

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(1a)



(1b)

in which

5            R<sup>1</sup>        independently of one another represents hydrogen or C<sub>1</sub>-C<sub>10</sub>-alkyl

and

10           R<sup>2</sup>        represents C<sub>1</sub>-C<sub>10</sub>-alkyl or in each case optionally unsubstituted or  
substituted phenyl or benzyl, the radicals mentioned for R<sup>1</sup> being  
preferred substituents for phenyl and benzyl.

15.    Use of the compounds according to claim 14 for the preparation of  
(co)polycarbonates.

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