

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
2 February 2006 (02.02.2006)

PCT

(10) International Publication Number
WO 2006/012250 A1

(51) International Patent Classification⁷: **C08L 69/00**,
79/08

FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO,
SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN,
GQ, GW, ML, MR, NE, SN, TD, TG).

(21) International Application Number:
PCT/US2005/022351

Declarations under Rule 4.17:

(22) International Filing Date: 23 June 2005 (23.06.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/878,954 28 June 2004 (28.06.2004) US

(71) Applicant (for all designated States except US): **GENERAL ELECTRIC COMPANY** [US/US]; (a New York Corporation), 1 River Road, Schenectady, NY 12345 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **GALLUCCI, Robert, R.** [US/US]; 1109 Tanglewood Drive, Mount Vernon, IN 47620 (US). **SANNER, Mark, A.** [US/US]; 6166 Laurel Ridge Drive, Newburgh, IN 47630 (US). **SYBERT, Paul, D.** [US/US]; 11620 Highway 66, Evansville, IN 47712 (US).

(74) Agents: **WINTER, Catherine, J.** et al.; Patent Counsel, General Electric Company, 3135 Easton Turnpike W3C, Fairfield, CT 06828 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

Published:

— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MISCIBLE POLYIMIDE BLENDS

(57) Abstract: Compositions made from a polyarylate or polyester carbonate containing greater than about 50 mole % resorcinol based ester linkages give miscible blends with polyimide resins. The blends of polyimides and resorcinol based polyesters or resorcinol based polyester carbonates also give miscible blends when combined with other aryl alkyl polyester resins.

WO 2006/012250 A1

MISCIBLE POLYIMIDE BLENDS

Field of the Invention

This invention relates to miscible blends of polyimides with resorcinol based polyesters or resorcinol based polyester carbonate polymers having improved flow and impact with high heat resistance and transparency.

Background of the Invention

Blending of polymers to make new compositions is well known. However finding polymer pairs that give useful mechanical properties is difficult. The unfavorable free energy of mixing for large polymeric molecules usually gives blends where the two polymers are separated from each other and have little or no affinity. These blends have poor mechanical properties and are not very useful for making molded articles or films. In some very limited instances two polymers show enough affinity to give sufficient adhesion between the two polymers that blends with good mechanical properties are obtained. In very rare instances the polymers have sufficient affinity to overcome the unfavorable thermodynamics of mixing and form an intimate mixture where the two polymers are dissolved in one another. Such miscible blends are very useful in that they are transparent, and often show good mechanical and rheological properties. Despite years of experimentation it is still very hard to predict, a priori, polymer miscibility.

We have found that a surprisingly small change in aryl polyester and aryl polyester carbonate structures allows one to go from blends that are phase separated and opaque to blends that are fully miscible and transparent. Incorporation of aryl ester linkages based on resorcinol, rather than bisphenol A (BPA), gives polyester carbonates that are miscible with polyimides, especially polyetherimides.

Even more surprising blends of three different polymers, resorcinol based polyester carbonates, polyimides and polyesters are also found to be miscible and transparent. Such miscible blends with polyimides are best achieved in compositions where the

polyester carbonates or polyarylates contain at least about 50 mole % resorcinol based aryl ester linkages.

Summary of the Invention

We have found that blends of polyimides with specific resorcinol based polyester resins and resorcinol based polyester carbonate resins are miscible showing a single glass transition (T_g). The compositions are quite specific requiring at least about 50 mole % resorcinol based linkages to demonstrate miscibility.

The surprising miscibility can also be observed in three component blends where the resorcinol based polyesters and polyester carbonates and polyimides are further combined with alky aryl polyesters such as polyethylene terephthalate (PET).

Both the two and three component blends have good flow and impact strength along with a high glass transition temperature and high heat distortion (HDT) temperatures. The miscible blends show good optical properties with high percent transmittance. Color is reduced compared to the base polyimide resins and melt processability is improved.

Detailed Description of the Invention

In one embodiment the composition will comprise 1-99% by weight of the entire mixture one or more of a resorcinol based polyarylate resin and 99-1 wt % of one or more polyimide resins. In another embodiment the composition will comprise 1-99% by weight of the entire mixture one or more of a resorcinol based polyester carbonate resin and 99-1 wt % of one or more polyimide resins.

The resorcinol based polyarylate resin should contain at least about 50 mole% of units derived from the reaction product of resorcinol, or functionalized resorcinol, with an aryl dicarboxylic acid or dicarboxylic acid derivatives suitable for the formation of aryl ester linkages, for example, carboxylic acid halides, carboxylic acid esters and carboxylic acid salts.

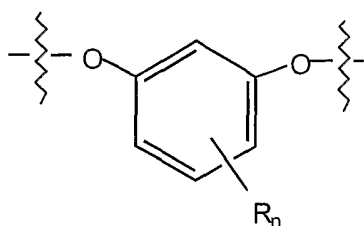
In another embodiment the composition will have a percent transmittance of greater than or equal to about 70% and a glass transition temperature (T_g) of greater than or equal to about 150 °C. The miscible polyetherimide – resorcinol based polyarylates or resorcinol based polyester carbonate blends will show high clarity and low haze and improved melt flow compared to the base polyimide resins.

The resorcinol-based polyarylate may further contain carbonate linkages derived from reaction of a bisphenol and a carbonate forming species, such as phosgene making a polyester carbonate copolymer.

In another embodiment of the invention resorcinol polyarylate carbonate copolymers will be comprised of the reaction products of iso and tere phthalic acid, resorcinol and optionally, bisphenol A and phosgene. In one aspect the resorcinol polyester carbonate copolymer will be made in such a way that the number of bisphenol dicarboxylic ester linkages is minimized, for example by pre-reacting the resorcinol moiety with the dicarboxylic acid moiety to form a polyester block and then reacting a said block with the bisphenol and carbonate moiety to form the polycarbonate part of the copolymer.

Some compositions of note will have 10-50% resorcinol based polyester with from 50-90% polyimide.

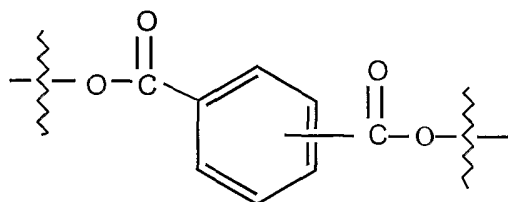
In one of its aspects the composition of the present invention is comprised of polymers containing arylate polyester chain members. Said chain members comprise at least one diphenol residue in combination with at least one aromatic dicarboxylic acid residue. In one embodiment the diphenol residue is derived from a 1,3-dihydroxybenzene moiety, as illustrated in Formula I, commonly referred to throughout this specification as resorcinol or resorcinol moiety. Resorcinol or resorcinol moiety as used within the context of the present invention should be understood to include both unsubstituted 1,3-dihydroxybenzene and substituted 1,3-dihydroxybenzenes unless explicitly stated otherwise.



Formula I

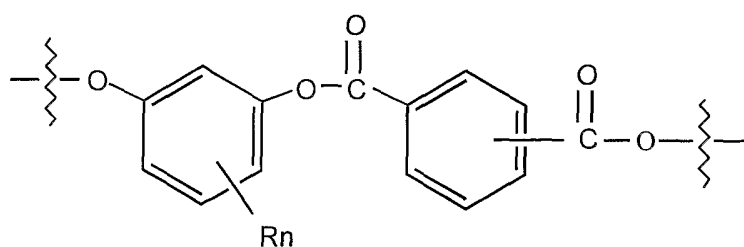
In Formula I R is at least one of C₁₋₁₂ alkyl, C_{6-C₂₄} aryl, alkyl aryl or halogen, and n is 0-3.

Suitable dicarboxylic acid residues include aromatic dicarboxylic acid residues derived from monocyclic moieties. In various embodiments suitable dicarboxylic acid residues include those derived from isophthalic acid, terephthalic acid, or mixtures of isophthalic and terephthalic acids. Suitable dicarboxylic acid residues also include those derived from polycyclic moieties, illustrative examples of which include diphenyl dicarboxylic acid, diphenylether dicarboxylic acid, and naphthalenedicarboxylic acid, especially naphthalene-2,6-dicarboxylic acid. In some embodiments the aromatic dicarboxylic acid residues are derived from mixtures of isophthalic and/or terephthalic acids as typically illustrated in Formula II.



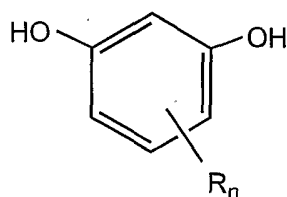
Formula II

Therefore, in one embodiment the present invention provides thermally stable polymers comprising resorcinol arylate polyester chain members as typically illustrated in Formula III wherein R and n are as previously defined:



Formula III

In one of its aspects the present invention provides a composition made of a resin prepared using an interfacial polymerization method preparing polymers comprising resorcinol arylate polyester chain members substantially free of anhydride linkages, said method comprising a first step of combining at least one resorcinol moiety and at least one catalyst in a mixture of water and at least one organic solvent substantially immiscible with water. Suitable resorcinol moieties comprise units of Formula IV :

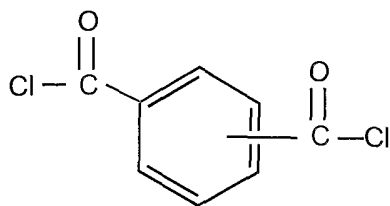


Formula IV

wherein R is at least one of C₁₋₁₂ alkyl, C₆₋₂₄ aryl, alkyl aryl or halogen, and n is 0-3. Alkyl groups, if present, are typically straight-chain, branched, or cyclic alkyl groups, and are most often located in the ortho position to both oxygen atoms although other ring locations are contemplated. Suitable C₁₋₁₂ alkyl groups include, but are not limited to, methyl, ethyl, n-propyl, isopropyl, butyl, iso-butyl, t-butyl, hexyl, cyclohexyl, nonyl, decyl, and aryl-substituted alkyl, including benzyl. In a particular embodiment an alkyl group is methyl. Suitable halogen groups are bromo, chloro, and fluoro. The value for n in various embodiments may be 0-3, in some embodiments 0-2, and in still other embodiments 0-1. In one embodiment a resorcinol moiety is 2-methylresorcinol. In another embodiment the resorcinol moiety is an unsubstituted resorcinol moiety in which n is zero. The method further comprises combining at least one catalyst with the reaction mixture. Said catalyst may be present in various

embodiments at a total level of 0.01 to 10 mole %, and in some embodiments at a total level of 0.2 to 6 mole % based on total molar amount of acid chloride groups. Suitable catalysts comprise tertiary amines, quaternary ammonium salts, quaternary phosphonium salts, hexaalkylguanidinium salts, and mixtures thereof. Suitable tertiary amines include triethylamine, dimethylbutylamine, diisopropylethylamine, 2,2,6,6-tetramethylpiperidine, and mixtures thereof. Other contemplated tertiary amines include N-C₁-C₆-alkyl-pyrrolidines, such as N-ethylpyrrolidine, N-C₁-C₆-piperidines, such as N-ethylpiperidine, N-methylpiperidine, and N-isopropylpiperidine, N-C₁-C₆-morpholines, such as N-ethylmorpholine and N-isopropyl-morpholine, N-C₁-C₆-dihydroindoles, N-C₁-C₆-dihydroisoindoles, N-C₁-C₆-tetrahydroquinolines, N-C₁-C₆-tetrahydroisoquinolines, N-C₁-C₆-benzo-morpholines, 1-azabicyclo-[3.3.0]-octane, quinuclidine, N-C₁-C₆-alkyl-2-azabicyclo-[2.2.1]-octanes, N-C₁-C₆-alkyl-2-azabicyclo-[3.3.1]-nonanes, and N-C₁-C₆-alkyl-3-azabicyclo-[3.3.1]-nonanes, N,N,N',N'-tetraalkylalkylene-diamines, including N,N,N',N'-tetraethyl-1,6-hexanediamine. In various embodiments tertiary amines are triethylamine and N-ethylpiperidine.

Suitable dicarboxylic acid dihalides may comprise aromatic dicarboxylic acid dichlorides derived from monocyclic moieties, illustrative examples of which include isophthaloyl dichloride, terephthaloyl dichloride, or mixtures of isophthaloyl and terephthaloyl dichlorides. Suitable dicarboxylic acid dihalides may also comprise aromatic dicarboxylic acid dichlorides derived from polycyclic moieties, illustrative examples of which include diphenyl dicarboxylic acid dichloride, diphenylether dicarboxylic acid dichloride, and naphthalenedicarboxylic acid dichloride, especially naphthalene-2,6-dicarboxylic acid dichloride; or from mixtures of monocyclic and polycyclic aromatic dicarboxylic acid dichlorides. In one embodiment the dicarboxylic acid dichloride comprises mixtures of isophthaloyl and/or terephthaloyl dichlorides as typically illustrated in Formula V.



Formula V

Either or both of isophthaloyl and terephthaloyl dichlorides may be present. In some embodiments the dicarboxylic acid dichlorides comprise mixtures of isophthaloyl and terephthaloyl dichloride in a molar ratio of isophthaloyl to terephthaloyl of about 0.25-4.0:1; in other embodiments the molar ratio is about 0.4-2.5:1; and in still other embodiments the molar ratio is about 0.67-1.5:1.

Dicarboxylic acid halides provide only one method of preparing the polymers on the invention. Other routes to make the resorcinol arylate linkages are also contemplated using, for example, the dicarboxylic acid, a dicarboxylic acid ester, especially an activated ester, or dicarboxylate salts or partial salts.

At least one chain-stopper (also referred to sometimes hereinafter as capping agent) may also be present in the method and compositions of the invention. A purpose of adding at least one chain-stopper is to limit the molecular weight of polymer comprising resorcinol arylate polyester chain members, thus providing polymer with controlled molecular weight and favorable processability. Typically, at least one chain-stopper is added when the resorcinol arylate-containing polymer is not required to have reactive end-groups for further application. In the absence of chain-stopper resorcinol arylate-containing polymer may be either used in solution or recovered from solution for subsequent use such as in copolymer formation which may require the presence of reactive end-groups, typically hydroxy, on the resorcinol-arylate polyester segments. A chain-stopper may be at least one of mono-phenolic compounds, mono-carboxylic acid chlorides, and/or mono-chloroformates. Typically, the at least one chain-stopper may be present in quantities of 0.05 to 10 mole %, based on resorcinol moieties in the case of mono-phenolic compounds and based on acid dichlorides in the case mono-carboxylic acid chlorides and/or mono-chloroformates.

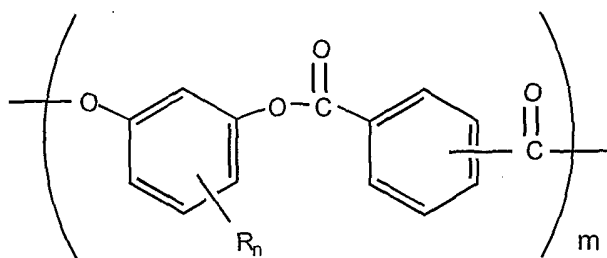
Suitable mono-phenolic compounds include monocyclic phenols, such as phenol, C₁-C₂₂ alkyl-substituted phenols, p-cumyl-phenol, p-tertiary-butyl phenol, hydroxy diphenyl; monoethers of diphenols, such as p-methoxyphenol. Alkyl-substituted phenols include those with branched chain alkyl substituents having 8 to 9 carbon atoms as described in U.S. Patent 4,334,053. In some embodiments mono-phenolic chain-stoppers are phenol, p-cumylphenol, and resorcinol monobenzoate.

Suitable mono-carboxylic acid chlorides include monocyclic, mono-carboxylic acid chlorides, such as benzoyl chloride, C₁-C₂₂ alkyl-substituted benzoyl chloride, toluoyl chloride, halogen-substituted benzoyl chloride, bromobenzoyl chloride, cinnamoyl chloride, 4-nadimidobenzoyl chloride, and mixtures thereof; polycyclic, mono-carboxylic acid chlorides, such as trimellitic anhydride chloride, and naphthoyl chloride; and mixtures of monocyclic and polycyclic mono-carboxylic acid chlorides. The chlorides of aliphatic monocarboxylic acids with up to 22 carbon atoms are also suitable. Functionalized chlorides of aliphatic monocarboxylic acids, such as acryloyl chloride and methacryoyl chloride, are also suitable. Suitable mono-chloroformates include monocyclic, mono-chloroformates, such as phenyl chloroformate, alkyl-substituted phenyl chloroformate, p-cumyl phenyl chloroformate, toluene chloroformate, and mixtures thereof.

A chain-stopper can be combined together with the resorcinol moieties, can be contained in the solution of dicarboxylic acid dichlorides, or can be added to the reaction mixture after production of a precondensate. If mono-carboxylic acid chlorides and/or mono-chloroformates are used as chain-stoppers, they are often introduced together with dicarboxylic acid dichlorides. These chain-stoppers can also be added to the reaction mixture at a moment when the chlorides of dicarboxylic acid have already reacted substantially or to completion. If phenolic compounds are used as chain-stoppers, they can be added in one embodiment to the reaction mixture during the reaction, or, in, cyanuric acid another embodiment, before the beginning of the reaction between resorcinol moiety and acid chloride moiety. When hydroxy-terminated resorcinol arylate-containing precondensate or oligomers are prepared, then chain-stopper may be absent or only present in small amounts to aid control of oligomer molecular weight.

In another embodiment the invention may encompass the inclusion of at least one branching agent such as a trifunctional or higher functional carboxylic acid chloride and/or trifunctional or higher functional phenol. Such branching agents, if included, can typically be used in quantities of 0.005 to 1 mole %, based on dicarboxylic acid dichlorides or resorcinol moieties used, respectively. Suitable branching agents include, for example, trifunctional or higher carboxylic acid chlorides, such as trimesic acid tri acid chloride, 3,3',4,4'-benzophenone tetracarboxylic acid tetrachloride, 1,4,5,8-naphthalene tetracarboxylic acid tetrachloride or pyromellitic acid tetrachloride, and trifunctional or higher phenols, such as 4,6-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-2-heptene, 4,6-dimethyl-2,4,6-tri-(4-hydroxyphenyl)-heptane, 1,3,5-tri-(4-hydroxyphenyl)-benzene, 1,1,1-tri-(4-hydroxyphenyl)-ethane, tri-(4-hydroxyphenyl)-phenyl methane, 2,2-bis-[4,4-bis-(4-hydroxyphenyl)-cyclohexyl]-propane, 2,4-bis-(4-hydroxyphenylisopropyl)-phenol, tetra-(4-hydroxyphenyl)-methane, 2,6-bis-(2-hydroxy-5-methylbenzyl)-4-methyl phenol, 2-(4-hydroxyphenyl)-2-(2,4-dihydroxyphenyl)-propane, tetra-(4-[4-hydroxyphenylisopropyl]-phenoxy)-methane, 1,4-bis-[(4,4-dihydroxytriphenyl)methyl]-benzene. Phenolic branching agents may be introduced first with the resorcinol moieties while acid chloride branching agents may be introduced together with acid dichlorides.

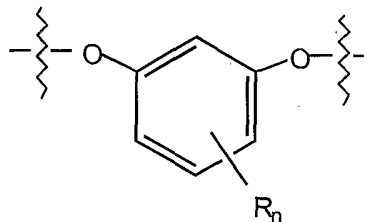
In one of its embodiments the invention comprises thermally stable resorcinol arylate polyesters made by the present method and substantially free of anhydride linkages linking at least two mers of the polyester chain. In a particular embodiment said polyesters comprise dicarboxylic acid residues derived from a mixture of iso- and terephthalic acids as illustrated in Formula VI:



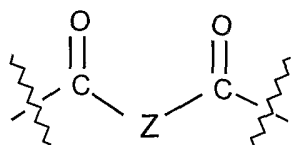
Formula VI

wherein R is at least one of C₁₋₁₂ alkyl, C₆-C₂₄ aryl, alkyl aryl or halogen, n is 0-3, and m is at least about 8. In various embodiments n is zero and m is between about 10 and about 300. The molar ratio of isophthalate to terephthalate is in one embodiment about 0.25-4.0:1, in another embodiment about 0.4-2.5:1, and in still another embodiment about 0.67-1.5:1. Substantially free of anhydride linkages means that said polyesters show decrease in molecular weight in one embodiment of less than 30% and in another embodiment of less than 10% upon heating said polymer at a temperature of about 280-290°C for five minutes.

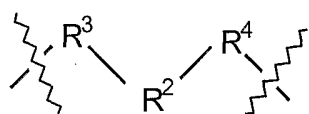
Also included in the scope of this invention are resorcinol arylate copolyesters containing soft-block segments as disclosed in commonly owned U.S. Patent No. 5,916,997. The term soft-block as used herein, indicates that some segments of the polymers are made from non-aromatic monomer units. Such non-aromatic monomer units are generally aliphatic and are known to impart flexibility to the soft-block-containing polymers. The copolymers include those comprising structural units of Formulas I, VII, and VIII:



Formula I

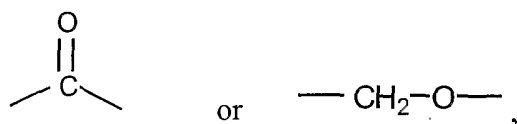


Formula VII



Formula VIII

wherein R and n are as previously defined, Z is a divalent aromatic radical, R² is a C₃₋₂₀ straight chain alkylene, C₃₋₁₀ branched alkylene, or C₄₋₁₀ cyclo- or bicycloalkylene group, and R³ and R⁴ each independently represent

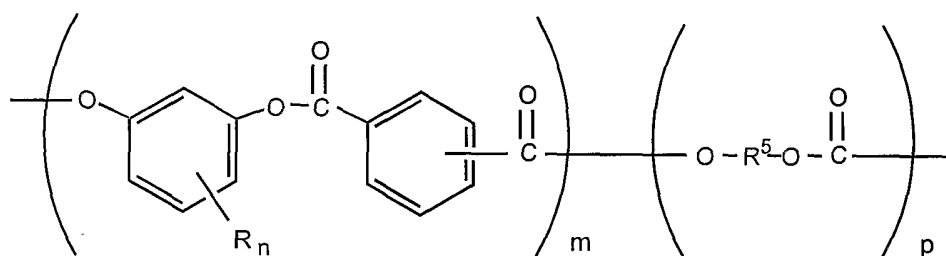


wherein Formula VIII contributes from about 1 to about 45 mole percent to the ester linkages of the polyester. Additional embodiments of the present invention provide a composition wherein Formula VIII contributes in various embodiments from about 5 to about 40 mole percent to the ester linkages of the polyester, and in other embodiments from about 5 to about 20 mole percent to the ester linkages of the polyester. Another embodiment provides a composition wherein R² represents in one embodiment C₃₋₁₄ straight chain alkylene, or C₅₋₆ cycloalkylene, and in another embodiment R² represents C₃₋₁₀ straight-chain alkylene or C₆-cycloalkylene. Formula VII represents an aromatic dicarboxylic acid residue. The divalent aromatic radical Z in Formula VII may be derived in various embodiments from at least one of the suitable dicarboxylic acid residues as defined hereinabove, and in some embodiments at least one of 1,3-phenylene, 1,4-phenylene, or 2,6-naphthylene. In various embodiments Z comprises at least about 40 mole percent 1,3-phenylene. In various embodiments of copolyesters containing soft-block chain members n in Formula I is zero.

In various embodiments copolyesters containing resorcinol arylate chain members are those comprising from about 1 to about 45 mole % sebacate or cyclohexane-1,4-dicarboxylate units. In a particular embodiment a copolyester containing resorcinol arylate chain members is one comprising resorcinol isophthalate and resorcinol sebacate units in molar ratio between 8.5:1.5 and 9.5:0.5. In one embodiment said copolyester is prepared using sebacyl chloride in combination with isophthaloyl dichloride.

In another of its embodiments the present invention comprises block copolyestercarbonates comprising resorcinol arylate-containing block segments in

combination with organic carbonate block segments. The segments comprising resorcinol arylate chain members in such copolymers are substantially free of anhydride linkages. Substantially free of anhydride linkages means that the copolyestercarbonates show decrease in molecular weight in one embodiment of less than 10% and in another embodiment of less than 5% upon heating said copolyestercarbonate at a temperature of about 280-290°C for five minutes. The block copolyestercarbonates include those comprising alternating arylate and organic carbonate blocks, typically as illustrated in Formula IX, wherein R and n are as previously defined, and R⁵ is at least one divalent organic radical :



Formula IX

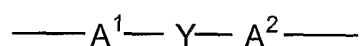
The arylate blocks have a degree of polymerization (DP), represented by m, in one embodiment of at least about 4, in another embodiment of at least about 10, in another embodiment of at least about 20 and in still another embodiment of about 30-150. The DP of the organic carbonate blocks, represented by p, is in one embodiment generally at least about 2, in another embodiment at least about 10-20 and in still another embodiment about 2-200. The distribution of the blocks may be such as to provide a copolymer having any desired weight proportion of arylate blocks in relation to carbonate blocks. In general, the content of arylate blocks is in one embodiment about 10-95% by weight and in another embodiment about 50-95% by weight.

Although a mixture of iso- and terephthalate is illustrated in Formula IX, the dicarboxylic acid residues in the arylate blocks may be derived from any suitable dicarboxylic acid residue, as defined hereinabove, or mixture of suitable dicarboxylic acid residues, including those derived from aliphatic diacid dichlorides (so-called "soft-block" segments). In various embodiments n is zero and the arylate blocks

comprise dicarboxylic acid residues derived from a mixture of iso- and terephthalic acid residues, wherein the molar ratio of isophthalate to terephthalate is in one embodiment about 0.25-4.0:1, in another embodiment about 0.4-2.5:1, and in still another embodiment about 0.67-1.5:1.

In the organic carbonate blocks, each R^5 is independently a divalent organic radical. In various embodiments said radical comprises at least one dihydroxy-substituted aromatic hydrocarbon, and at least about 60 percent of the total number of R^5 groups in the polymer are aromatic organic radicals and the balance thereof are aliphatic, alicyclic, or aromatic radicals. Suitable R^5 radicals include m-phenylene, p-phenylene, 4,4'-biphenylene, 4,4'-bi(3,5-dimethyl)-phenylene, 2,2-bis(4-phenylene)propane, 6,6'-(3,3,3',3'-tetramethyl-1,1'-spirobi[1H-indan]) and similar radicals such as those which correspond to the dihydroxy-substituted aromatic hydrocarbons disclosed by name or formula (generic or specific) in U.S. Patent 4,217,438.

In some embodiments each R^5 is an aromatic organic radical and in other embodiments a radical of Formula X:



Formula X

wherein each A^1 and A^2 is a monocyclic divalent aryl radical and Y is a bridging radical in which one or two carbon atoms separate A^1 and A^2 . The free valence bonds in Formula X are usually in the meta or para positions of A^1 and A^2 in relation to Y. Compounds in which R^5 has Formula X are bisphenols, and for the sake of brevity the term "bisphenol" is sometimes used herein to designate the dihydroxy-substituted aromatic hydrocarbons. It should be understood, however, that non-bisphenol compounds of this type may also be employed as appropriate.

In Formula X, A^1 and A^2 typically represent unsubstituted phenylene or substituted derivatives thereof, illustrative substituents (one or more) being alkyl, alkenyl, and halogen (particularly bromine). In one embodiment unsubstituted phenylene radicals

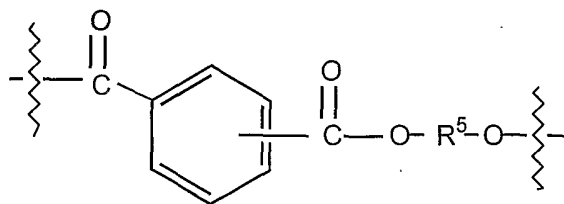
are preferred. Both A^1 and A^2 are often p-phenylene, although both may be o- or m-phenylene or one o- or m-phenylene and the other p-phenylene.

The bridging radical, Y, is one in which one or two atoms, separate A^1 from A^2 . In a particular embodiment one atom separates A^1 from A^2 . Illustrative radicals of this type are -O-, -S-, -SO- or -SO₂-, methylene, cyclohexyl methylene, 2-[2.2.1]-bicycloheptyl methylene, ethylene, isopropylidene, neopentylidene, cyclohexylidene, cyclopentadecylidene, cyclododecylidene, adamantylidene, and like radicals.

In some embodiments gem-alkylene (commonly known as "alkylidene") radicals are preferred. Also included, however, are unsaturated radicals. In some embodiments the preferred bisphenol is 2,2-bis(4-hydroxyphenyl)propane (bisphenol-A or BPA), in which Y is isopropylidene and A^1 and A^2 are each p-phenylene. Depending upon the molar excess of resorcinol moiety present in the reaction mixture, R^5 in the carbonate blocks may at least partially comprise resorcinol moiety. In other words, in some embodiments of the invention carbonate blocks of Formula X may comprise a resorcinol moiety in combination with at least one other dihydroxy-substituted aromatic hydrocarbon.

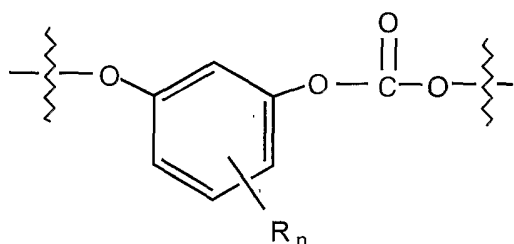
Diblock, triblock, and multiblock copolyestercarbonates are encompassed in the present invention. The chemical linkages between blocks comprising resorcinol arylate chain members and blocks comprising organic carbonate chain members may comprise at least one of:

(a) an ester linkage between a suitable dicarboxylic acid residue of an arylate moiety and an $-O-R^5-O-$ moiety of an organic carbonate moiety, for example as typically illustrated in Formula XI, wherein R^5 is as previously defined :



Formula XI

and (b) a carbonate linkage between a diphenol residue of a resorcinol arylate moiety and a $-(C=O)-O-$ moiety of an organic carbonate moiety as shown in Formula XII, wherein R and n are as previously defined :



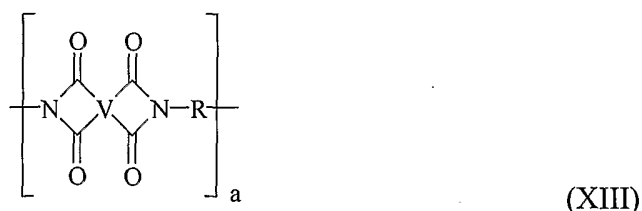
Formula XII

The presence of a significant proportion of ester linkages of the type (a) may result in undesirable color formation in the copolyestercarbonates. Although the invention is not limited by theory, it is believed that color may arise, for example, when R^5 in Formula XI is bisphenol A and the moiety of Formula XI undergoes Fries rearrangement during subsequent processing and/or light-exposure. In one embodiment the copolyestercarbonate is substantially comprised of a diblock copolymer with a carbonate linkage between resorcinol arylate block and an organic carbonate block. In another embodiment the copolyestercarbonate is substantially comprised of a triblock carbonate-ester-carbonate copolymer with carbonate linkages between the resorcinol arylate block and organic carbonate end-blocks.

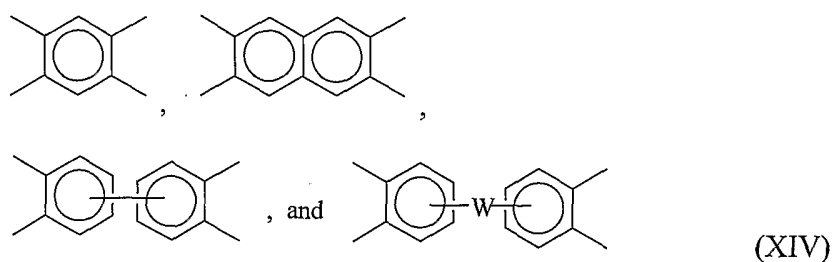
Copolyestercarbonates with at least one carbonate linkage between a thermally stable resorcinol arylate block and an organic carbonate block are typically prepared from resorcinol arylate-containing oligomers prepared by various embodiments of the invention and containing in one embodiment at least one and in another embodiment at least two hydroxy-terminal sites. Said oligomers typically have weight average molecular weight in one embodiment of about 10,000 to about 40,000, and in another embodiment of about 15,000 to about 30,000. Thermally stable copolyestercarbonates may be prepared by reacting said resorcinol arylate-containing oligomers with

phosgene, at least one chain-stopper, and at least one dihydroxy-substituted aromatic hydrocarbon in the presence of a catalyst such as a tertiary amine.

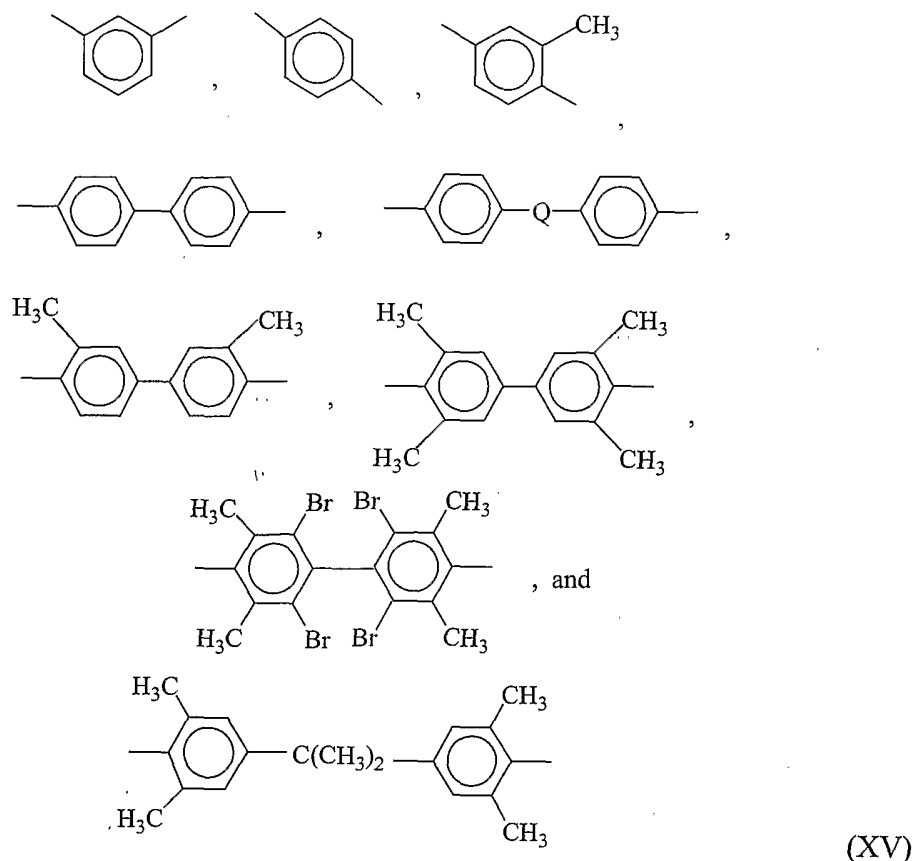
Thermoplastic polyimides have the general formula (XIII)



wherein a is more than 1, typically about 10 to about 1000 or more, and more preferably about 10 to about 500; and wherein V is a tetravalent linker without limitation, as long as the linker does not impede synthesis or use of the polyimide. Suitable linkers include but are not limited to: (a) substituted or unsubstituted, saturated, unsaturated or aromatic monocyclic and polycyclic groups having about 5 to about 50 carbon atoms, (b) substituted or unsubstituted, linear or branched, saturated or unsaturated alkyl groups having 1 to about 30 carbon atoms; or combinations thereof. Suitable substitutions and/or linkers include, but are not limited to, ethers, epoxides, amides, esters, and combinations thereof. Preferred linkers include but are not limited to tetravalent aromatic radicals of formula (XIV), such as



wherein W is a divalent moiety selected from the group consisting of $-O-$, $-S-$, $-C(O)-$, $-SO_2-$, $-SO-$, $-C_yH_{2y}-$ (y being an integer from 1 to 5), and fluorinated derivatives thereof, including perfluoroalkylene groups, or a group of the formula $-O-Z-O-$ wherein the divalent bonds of the $-O-$ or the $-O-Z-O-$ group are in the 3,3', 3,4', 4,3', or the 4,4' positions, and wherein Z includes, but is not limited, to divalent radicals of formula (XV).



R in formula (XIII) includes but is not limited to substituted or unsubstituted divalent organic radicals such as: (a) aromatic hydrocarbon radicals having about 6 to about 20 carbon atoms and halogenated derivatives thereof; (b) straight or branched chain alkylene radicals having about 2 to about 20 carbon atoms; (c) cycloalkylene radicals having about 3 to about 20 carbon atoms, or (d) divalent radicals of the general formula (XVI)

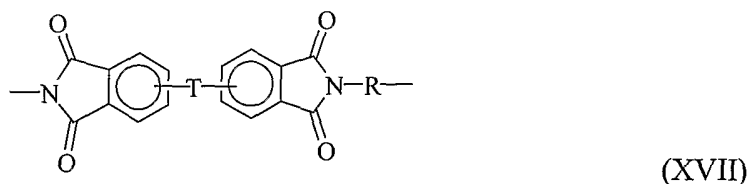


wherein Q includes but is not limited to a divalent moiety selected from the group consisting of -O-, -S-, -C(O)-, -SO₂-, -SO-, -C_yH_{2y}- (y being an integer from 1 to 5), and fluorinated derivatives thereof, including perfluoroalkylene groups.

Preferred classes of polyimides include polyamidimides and polyetherimides, particularly those polyetherimides known in the art which are melt processable, such

as those whose preparation and properties are described in U.S. Patent Nos. 3,803,085 and 3,905,942.

Preferred polyetherimide resins comprise more than 1, typically about 10 to about 1000 or more, and more preferably about 10 to about 500 structural units, of the formula (XVII)

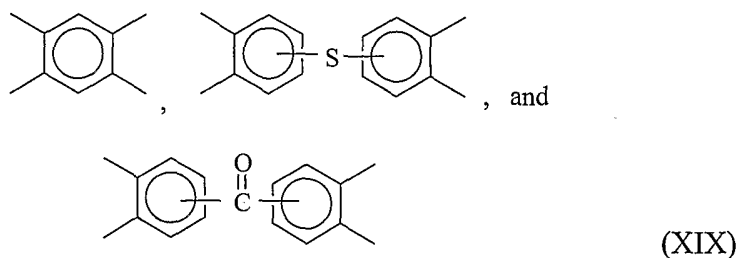


wherein T is -O- or a group of the formula -O-Z-O- wherein the divalent bonds of the -O- or the -O-Z-O- group are in the 3,3', 3,4', 4,3', or the 4,4' positions, and wherein Z includes, but is not limited, to divalent radicals of formula (XV) as defined above.

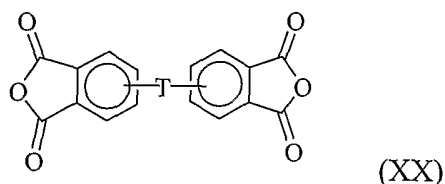
In one embodiment, the polyetherimide may be a copolymer, which, in addition to the etherimide units described above, further contains polyimide structural units of the formula (XVIII)



wherein R is as previously defined for formula (XIII) and M includes, but is not limited to, radicals of formula (XIX).



The polyetherimide can be prepared by any of the methods well known to those skilled in the art, including the reaction of an aromatic bis(ether anhydride) of the formula (XX)



with an organic diamine of the formula (XXI)



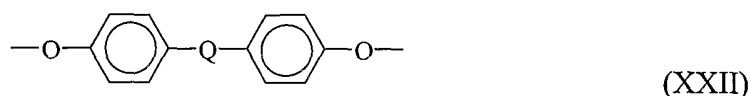
wherein T and R are defined as described above in formulas (XIII) and (XVI).

Examples of specific aromatic bis(ether anhydride)s and organic diamines are disclosed, for example, in U.S. Patent Nos. 3,972,902 and 4,455,410, which are incorporated herein by reference. Illustrative examples of aromatic bis(ether anhydride)s of formula (XX) include:

3,3-bis[4-(3,4-dicarboxyphenoxy)phenyl]propane		dianhydride;	4,4'-bis(3,4-dicarboxyphenoxy)diphenyl
	ether	dianhydride;	4,4'-bis(3,4-dicarboxyphenoxy)diphenyl
	sulfide	dianhydride;	4,4'-bis(3,4-dicarboxyphenoxy)benzophenone
		dianhydride;	4,4'-bis(3,4-dicarboxyphenoxy)diphenyl
	sulfone	dianhydride;	2,2-bis[4-(2,3-dicarboxyphenoxy)phenyl]propane
		dianhydride;	4,4'-bis(2,3-dicarboxyphenoxy)diphenyl
	ether	dianhydride;	4,4'-bis(2,3-dicarboxyphenoxy)diphenyl
	sulfide	dianhydride;	4,4'-bis(2,3-dicarboxyphenoxy)benzophenone
		dianhydride;	4,4'-bis(2,3-dicarboxyphenoxy)diphenyl
4-(2,3-dicarboxyphenoxy)-4'-(3,4-dicarboxyphenoxy)diphenyl-2,2-propane		dianhydride;	4-(2,3-dicarboxyphenoxy)-4'-(3,4-dicarboxyphenoxy)diphenyl
	ether	dianhydride;	4-(2,3-dicarboxyphenoxy)-4'-(3,4-dicarboxyphenoxy)diphenyl
	sulfide	dianhydride;	4-(2,3-dicarboxyphenoxy)-4'-(3,4-dicarboxyphenoxy)benzophenone
		dianhydride and	4-(2,3-dicarboxyphenoxy)-4'-(3,4-dicarboxyphenoxy)benzophenone

(3,4-dicarboxyphenoxy)diphenyl sulfone dianhydride, as well as various mixtures thereof.

The bis(ether anhydride)s can be prepared by the hydrolysis, followed by dehydration, of the reaction product of a nitro substituted phenyl dinitrile with a metal salt of dihydric phenol compound in the presence of a dipolar, aprotic solvent. A preferred class of aromatic bis(ether anhydride)s included by formula (XX) above includes, but is not limited to, compounds wherein T is of the formula (XXII)

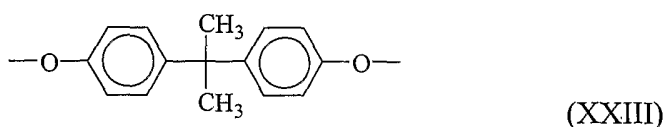


and the ether linkages, for example, are preferably in the 3,3', 3,4', 4,3', or 4,4' positions, and mixtures thereof, and where Q is as defined above.

Any diamino compound may be employed in the method of this invention. Examples of suitable compounds are ethylenediamine, propylenediamine, trimethylenediamine, diethylenetriamine, triethylenetetramine, hexamethylenediamine, heptamethylenediamine, octamethylenediamine, nonamethylenediamine, decamethylenediamine, 1,12-dodecanediamine, 1,18-octadecanediamine, 3-methylheptamethylenediamine, 4,4-dimethylheptamethylenediamine, 4-methylnonamethylenediamine, 5-methylnonamethylenediamine, 2,5-dimethylhexamethylenediamine, 2,5-dimethylheptamethylenediamine, 2, 2-dimethylpropylenediamine, N-methyl-bis (3-aminopropyl) amine, 3-methoxyhexamethylenediamine, 1,2-bis(3-aminopropoxy) ethane, bis(3-aminopropyl) sulfide, 1,4-cyclohexanediamine, bis-(4-aminocyclohexyl) methane, m-phenylenediamine, p-phenylenediamine, 2,4-diaminotoluene, 2,6-diaminotoluene, m-xylylenediamine, p-xylylenediamine, 2-methyl-4,6-diethyl-1,3-phenylene-diamine, 5-methyl-4,6-diethyl-1,3-phenylene-diamine, benzidine, 3,3'-dimethylbenzidine, 3,3'-dimethoxybenzidine, 1,5-diaminonaphthalene, bis(4-aminophenyl) methane, bis(2-chloro-4-amino-3, 5-diethylphenyl) methane, bis(4-aminophenyl) propane, 2,4-bis(b-amino-t-butyl) toluene, bis(p-b-amino-t-butylphenyl) ether, bis(p-b-methyl-o-aminophenyl) benzene, bis(p-b-methyl-o-aminopentyl) benzene, 1, 3-diamino-4-

isopropylbenzene, bis(4-aminophenyl) sulfide, bis (4-aminophenyl) sulfone, bis(4-aminophenyl) ether and 1,3-bis(3-aminopropyl) tetramethyldisiloxane. Mixtures of these compounds may also be present. The preferred diamino compounds are aromatic diamines, especially m- and p-phenylenediamine, sulfonyl dianiline and mixtures thereof.

In one embodiment, the polyetherimide resin comprises structural units according to formula (V) wherein each R is independently p-phenylene or m-phenylene or a mixture thereof and T is a divalent radical of the formula (XXIII)



Included among the many methods of making the polyimides, particularly polyetherimides, are those disclosed in U. S. Patent Nos. 3,847,867, 3,850,885, 3,852,242, 3,855,178, 3,983,093, and 4,443,591. These patents mentioned for the purpose of teaching, by way of illustration, general and specific methods for preparing polyimides.

Polyetherimides have a melt index of about 0.1 to about 10 grams per minute (g/min), as measured by American Society for Testing Materials (ASTM) D1238 at 340-370°C, using a 6.6 kilogram (kg) weight. In a one embodiment, the polyetherimide resin has a weight average molecular weight (Mw) of about 10,000 to about 150,000 grams per mole (g/mole), as measured by gel permeation chromatography, using a polystyrene standard. In another embodiment the polyetherimide has Mw of 20,000 to 60,000. Such polyetherimide resins typically have an intrinsic viscosity greater than about 0.2 deciliters per gram (dl/g), preferably about 0.35 to about 0.7 dl/g measured in m-cresol at 25°C.

Examples of some polyetherimides useful in blends described herein are listed in ASTM D5205-96 "Standard Classification System for Polyetherimide (PEI) Materials.

Polyimide is present in amounts of about 1 to about 99 weight percent, based on the total weight of the composition. Within this range, the amount of polyimide may be greater than or equal to about 20, more specifically greater than or equal to about 50, and even more specifically greater than or equal to about 70 weight percent. Also within this range, the amount of polyimide may be less than or equal to about 90, more specifically less than or equal to about 80 and even more specifically less than or equal to about 75 weight percent.

In another embodiment a composition comprising a miscible polymer blend of;

- a) 1-99% of a polyetherimide,
- b) 99-1% of an aryl polyester resin containing at least 50 mole% resorcinol linkages,
- c) 0-30% of an aryl alkyl polyester
- d) 0-2% of a phosphorus containing stabilizer,

is contemplated.

In other aspect a composition comprising a miscible polymer blend of;

- a) 50-99% by weight of one or more polyetherimide resins,
- b) 1-50% by weight of one or more aryl polyester carbonate resins containing at least 50 mole% resorcinol linkages,
- c) 0-30% by weight of one or more aryl alkyl polyester resins
- d) 0-2% by weight of one or more phosphorus containing stabilizers,

is contemplated.

The compositions of the invention can also be combined with various additives including, but not limited to, colorants such as titanium dioxide, zinc sulfide and carbon black; stabilizers such as hindered phenols, phosphites, phosphonites,

thioesters and mixtures thereof, as well as mold release agents, lubricants, flame retardants, smoke suppressors and anti-drip agents, for example, those based on fluoro polymers. Use of phosphonate or phosphite compounds or mixtures thereof may be desired in some instances to improve color and stability. In another instance aryl phosphonate, phosphite compounds or mixtures thereof or in combination with hindered phenol antioxidants may be employed. Flame retardants based on sulfonate salts, such as perfluoro alkyl metal sulfonates, aryl sulfonate salts or mixtures thereof may be useful. Bromo or chloro compounds can also be employed as flame retardants in some instances. Ultraviolet light stabilizers can also be added to the compositions in effective amounts. These additives are known in the art, as are their effective levels and methods of incorporation. Effective amounts of the additives vary widely, but they are usually present in an amount up to about 0.01- 30% or more by weight, based on the weight of the entire composition. In some instances additives, which result in compositions that retain transparency and low haze, may be desired.

Examples of mold release agents are alkyl carboxylic acid esters, for example, penta erythritol tetrastearate, glycerin tristearate and ethylene glycol distearate. Mold release agents are typically present in the composition at 0.05-0.5% by weight of the formulation. Preferred mold release agents will have high molecular weight, typically greater than about 200, to prevent loss of the release agent from the molten polymer fiber mixture during melt processing.

The compositions of the present invention can be blended with the aforementioned ingredients by a variety of methods involving intimate admixing of the materials with any additional additives desired in the formulation. A preferred procedure includes melt blending, although solution blending is also possible. Because of the availability of melt blending equipment in commercial polymer processing facilities, melt processing methods are generally preferred. Illustrative examples of equipment used in such melt processing methods include: co-rotating and counter-rotating extruders, single screw extruders, co-kneaders, disc-pack processors and various other types of extrusion equipment. The temperature of the melt in the present process is preferably minimized in order to avoid excessive degradation of the resins. It is often desirable to maintain the melt temperature between about 250°C and about 370°C in the molten

resin composition, although higher temperatures can be used provided that the residence time of the resin in the processing equipment is kept short. In some embodiments the melt processed composition exits processing equipment such as an extruder through small exit holes in a die, and the resulting strands of molten resin are cooled by passing the strands through a water bath. The cooled strands can be chopped into small pellets for packaging and further handling.

The compositions of the invention can be prepared by any number of methods. Preferred methods include, for example, injection molding, compression molding, profile extrusion, sheet or film extrusion, gas assist molding, structural foam molding and thermoforming. Examples of such articles include, but are not limited to, cookware, food service items, medical devices, trays, plates, handles, helmets, animal cages, electrical connectors, enclosures for electrical equipment, engine parts, automotive engine parts, lighting sockets and reflectors, electric motor parts, power distribution equipment, communication equipment, computers and the like, including devices that have molded in snap fit connectors. The resorcinol polyarylate based blends described herein resins can also be made into film and sheet as well as components of laminate systems.

Without further elaboration, it is believed that one skilled in the art can, using the description herein, utilize the present invention. The following examples are included to provide addition guidance to those skilled in the art of practicing the claimed invention. The examples provided are merely representative of the work and contribute to the teaching of the present invention. Accordingly, these examples are not intended to limit the invention in any manner.

Examples of the Invention

Blends were prepared by extrusion of mixtures of resorcinol based polyester carbonate resin with polyetherimide or polyetherimide sulfone resin in a 2.5 inch single screw, vacuum vent extruder. All compositions are listed in wt% of the total composition. All resorcinol polyester carbonate blends had 0.06% of a triaryl phosphite stabilizer added prior to extrusion. The extruder was set at about 285 to

340 °C. The blends were run at about 90 ppm under vacuum. The extrudate was cooled, pelletized and dried at 120 °C. Test samples were injection molded at a set temperature of 340-350 °C and mold temperature of 120 °C using a 30 sec. cycle time. Properties were measured using ASTM test methods.

Melt flow index (MFI) was run on dried pellets as per ASTM D1238 at 337 °C using a 6.6 Kg weight. All molded samples were conditioned for at least 48h at 50% relative humidity prior to testing.

Izod impact values were measured at room temperature on 3.1 mm thick bars as per ASTM D256. Tg was measured by differential scanning calorimetry on the second scan with a heating rate of 20 °C/ min. using ASTM method D3418. Heat distortion temperature (HDT) was measured at 0.45 and 1.82 MPa on 3.1 mm thick bars as per ASTM D648. Percent transmission (%T) was measured as per ASTM D1003 on 3.1 mm injection molded parts. Biaxial, or instrumented impact, was measured on 102 x 3.1 mm discs at 23, 0 and -20 °C using ASTM method D3763, total impact energy is reported. Yellowness index (YI) was measured on 3.1 mm injection molded chips as per ASTM method D6290. Note that letters designate comparative examples while numbers designate examples of the invention.

Materials

ITR resins are polymers made from the condensation of a 1:1 mixture of iso and terephthaloyl chloride with resorcinol, bisphenol A (BPA) and phosgene.

The polymers are named by the approximate mole ratio of ester linkages to carbonate linkages.

ITR9010: about 81 mole % resorcinol ester linkages, 8 mole % resorcinol carbonate linkages and about 11 mole % BPA carbonate linkages. Tg = 131°C

ITR8020: about 74 mole % resorcinol ester linkages, 7 mole% resorcinol carbonate linkages and about 19 mole % BPA carbonate linkages. Tg = 130 °C

ITR6040: about 51 mole % resorcinol ester linkages, 15 mole% resorcinol carbonate linkages and about 34 mole % BPA carbonate linkages. Tg = 125°C

ITR2080: about 19 mole % resorcinol ester linkages, 6 mole% resorcinol carbonate linkages and about 75 mole % BPA carbonate linkages. Tg = 136°C

PEI = ULTEM 1000 polyetherimide from GE Plastics

PEIS = ULTEM XH6050 polyetherimide sulfone from GE Plastics

PET = 0.85 IV polyethylene terephthalate from Kosa Co.

Examples A-E, 1-4 (Table 1) show blends of PEI with ITR 6040 and ITR 2080 as well as a PEI control resin. Note that the ITR 6040 blends (~51 mole % resorcinol ester linkages), examples 1-4, were all clear, showing a %T of over 70%. Control experiments B-E with ITR2080 (about 19 mole % resorcinol based ester linkages) were opaque with low %T, this shows the importance of having high mole % resorcinol linkages in the polyester carbonate resin in order to achieve a miscible blend. Compared to the PEI control (example A) examples 1-4 show superior low temperature biaxial impact as well as better melt flow (higher MFI). Examples 1-4 also demonstrate increased %T with reduced yellowness (YI).

Table 1	A	1	2	3	4	B	C	D	E
PEI	100	94.94	89.94	79.94	69.94	94.94	89.94	79.94	69.94
ITR 6040	0	5.0	10.0	20.0	30.0	0	0	0	0
ITR 2080	0	0	0	0	0	5.0	10.0	20.0	30.0
Unnotched Izod J/m	1338	2136	2136	2136	2136	2083	2136	2136	2136
Notched Izod	37	48	37	37	43	43	53	59	75
Reversed Notched Izod	1233	2083	2136	2136	2136	2136	2136	2136	2136
Biaxial Impact 23 C J	84	75	62	91	86	88	98	85	90
Biaxial Impact 0 C	34	86	50	81	82	63	55	91	70
Biaxial Impact -20 C	11	51	44	47	50	41	43	61	76
Tg C	218	218	215	203	193	220	219	221	215
HDT@ 0.45MPa C	205	203	198	188	178	206	203	200	195
HDT@ 1.82 MPa C	188	186	180	172	163	187	184	177	173
% Transmission	62	71	73	74	76	40	20	8	5
Yellowness Index	75	60	58	56	53	101	122	138	148
MFI @ 337 C, 6.6 kg	0.90	1.25	1.48	2.20	3.09	1.10	1.23	1.39	2.03

All blends had 0.06 wt% triaryl phosphite stabilizer

Biaxial impact measured as total energy J

Table 2 shows further examples of the invention. Examples 9-11 show transparent, high flow blends of PEI with ITR9010 (about 81 mole % resorcinol based ester linkages). Example 11 shows that higher levels of ITR, with greater than 50% resorcinol based linkages, blended with PEI still retain transparency. Example 12 shows a transparent PEI blend with ITR8020 (about 74 mole % resorcinol based ester linkages). Example 13 shows a transparent, low color, high flow blend of ITR 9010 with a polyetherimide sulfone (PEIS).

Table 2

Examples	9	10	11	12	13
PEI	82.44	69.94	49.94	69.94	0
PEIS	0	0	0	0	49.94
ITR 9010	17.5	30.0	50.0	0	50.0
ITR 8020	0	0	0	30.0	0
Unnotched Izod J/m	2136	2136	2136	2136	2136
Notched Izod	43	54	69	54	96
Reversed Notched Izod	2136	nm	2136	nm	2136
Biaxial Impact 23 °C	94	nm	92	nm	41
Tg °C	205	192	182	194	181
HDT@ 0.45MPa C	194	nm	170	nm	168
HDT@ 1.82 MPa C	179	175	158	176	156
% Transmission	72	72	73	74	69
Yellowness Index	61	62	60	60	75

All blends had 0.06 wt% triaryl phosphite stabilizer

nm = not measured

Table 3 shows examples of three component transparent blends of PEI, ITR 9010 and PET. The three resins were mixed together, extruded and injection molded as described above. Example F is a control blend of PET with PEI. Examples 14 and 15,

blends of the resorcinol based polyester carbonate, PEI and PET, show improved Izod impact, increased %T and higher HDT compared to the control sample F.

Table 3

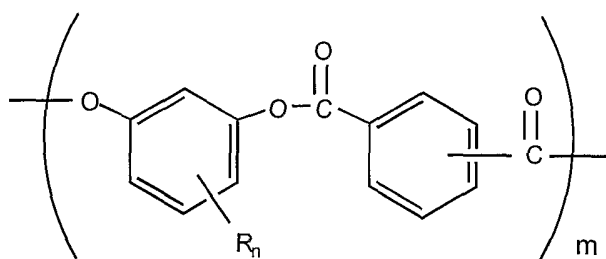
Examples	F	14	15
PEI	82.44	82.44	82.44
PEIS	0	0	0
ITR 9010	0	5.0	10.0
PET	17.5	12.5	7.5
Unnotched Izod J/m	1463	1650	2136
Notched Izod	27	43	53
Reversed Notched Izod	1015	1191	1773
Biaxial Impact 23 C	4	9	39
Tg C	190	190	192
HDT@ 0.45MPa C	167	174	181
HDT@ 1.82 MPa C	155	162	169
% Transmission	67	74	76
Yellowness Index	63	56	55

All blends had 0.06 wt% triaryl phosphite stabilizer

We claim:

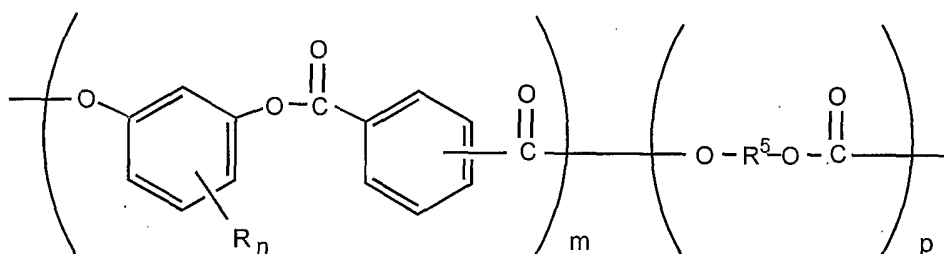
1. A composition comprising a miscible polymer blend of one or more polyimide resins and a second resin selected from the group consisting of resorcinol based polyester carbonates, resorcinol based polyarylates and mixtures thereof, wherein said polyester carbonates and polyarylates have at least 50 mole% aryl ester linkages derived from resorcinol.
2. The composition of claim 1 wherein the polyimide resin is selected from the group consisting of; polyetherimides, polyetherimide sulfones and mixtures thereof.
3. The composition of claim 1 wherein the polyimide is made from
 - (a) aryl dianhydrides selected from the group consisting of: bisphenol A dianhydride, oxydiphthalic anhydride, pyromellitic dianhydride, diphthalic anhydride, sulfonyl dianhydride, benzophenone dianhydride and mixtures thereof and,
 - (b) aryl diamines selected from the group consisting of meta phenylene diamine, para phenylene diamine, diamino diphenyl sulfone, oxydianiline, bis amino phenoxy benzene, bis aminophenoxy biphenyl, bis aminophenyl phenyl sulfone, diamino diphenyl sulfide and mixtures thereof.
4. The composition of claim 1 further comprising a phosphorus containing stabilizer.
5. The composition of claim 4 further comprising a stabilizer selected from the group consisting of phosphites, phosphonites and mixtures thereof.
6. The composition of claim 1 wherein the miscible polymer blend has a percent transmittance, as measured by ASTM D1003, of greater than or equal to about 50%.
7. The composition of claim 1 wherein the miscible polymer blend has a glass transition temperature, as measured by ASTM D3418, of greater than or equal to about 150 °C.

8. The composition of claim 1 wherein the miscible polymer blend has an Izod, impact, as measured by ASTM D256, of greater than or equal to about 100 J/m.
9. The composition of claim 1 further comprising one or more aryl polyester resins.
10. The composition of claim 9 wherein the aryl polyester resin is chosen from the group consisting of; polyethylene terephthalate, polybutylene terephthalate, polypropylene terephthalate, polyethylene naphthanoate, polybutylene naphthanoate, polypropylene naphthanoate, polycyclohexanedimethanol terephthalate and mixtures thereof.
11. A composition comprising a miscible polymer blend of:
 - a) 1-99% of a polyetherimide,
 - b) 99-1% of an aryl polyester resin containing at least 50 mole% resorcinol linkages,
 - c) 0-30% of an aryl alkyl polyester
 - d) 0-2% of a phosphorus containing stabilizer,
12. A composition of claim 11 comprising a miscible polymer blend of;
 - a) 50-99% by weight of one or more polyetherimide resins,
 - b) 1-50% by weight of one or more aryl polyester carbonate resin containing at least 50 mole% resorcinol linkages,
 - c) 0-30% by weight of one or more aryl alkyl polyester resins,
 - d) 0-2% by weight of one or more phosphorus containing stabilizers.
13. The composition of claim 1 wherein the resorcinol based polyarylate has the structure shown below:



wherein R is at least one of C₁₋₁₂ alkyl, C₆-C₂₄ aryl, alkyl aryl or halogen, n is 0-3 and m is at least about 8.

14. The composition of claim 1 wherein the resorcinol based polyester carbonate resin is a copolymer containing carbonate linkages having the structure shown below:



wherein R is at least one of C₁₋₁₂ alkyl, C₆-C₂₄ aryl, alkyl aryl or halogen, n is 0-3. R⁵ is at least one divalent organic radical, m is about 4 – 150 and p is about 2-200.

15. The composition of claim 14 wherein R⁵ is derived from a bisphenol compound.

16. The composition of claim 1 further comprising an ester based mold release agent.

17. The composition of claim 16 wherein the ester based mold release agent has a molecular weight of greater than or equal to about 200.

18. The composition of claim 1 further comprising a flame retardant agent selected from the group consisting of: bromine or chlorine containing compounds, sulfonate salts, organo-phosphates, fluorinated polymers or mixtures thereof.

19. An article made from the composition of claim 1.

20. An article of claim 19 which is transparent with a % transmittance, as measured by ASTM D1003, of greater than or equal to 50%.

INTERNATIONAL SEARCH REPORT

International Application No
US2005/022351

A. CLASSIFICATION OF SUBJECT MATTER C08L69/00 C08L79/08 //((C08L79/08,69:00),(C08L69/00,79:08)																	
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) 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, PAJ, CHEM ABS Data																	
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category *</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>EP 0 594 386 A (GENERAL ELECTRIC COMPANY) 27 April 1994 (1994-04-27) page 6, line 59 - page 7, line 4; claim 1 page 9, line 22 - line 24</td> <td>1-11, 13-20</td> </tr> <tr> <td>A</td> <td>US 2001/016626 A1 (VOLLENBERG PETER HENDRIKUS THEODORUS ET AL) 23 August 2001 (2001-08-23) paragraph '0070!; claims 1,21</td> <td>1-20</td> </tr> <tr> <td>A</td> <td>US 4 548 997 A (MELLINGER ET AL) 22 October 1985 (1985-10-22) claims 1-7</td> <td>1-20</td> </tr> <tr> <td></td> <td style="text-align: center;">----- -/--</td> <td></td> </tr> </tbody> </table>			Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	EP 0 594 386 A (GENERAL ELECTRIC COMPANY) 27 April 1994 (1994-04-27) page 6, line 59 - page 7, line 4; claim 1 page 9, line 22 - line 24	1-11, 13-20	A	US 2001/016626 A1 (VOLLENBERG PETER HENDRIKUS THEODORUS ET AL) 23 August 2001 (2001-08-23) paragraph '0070!; claims 1,21	1-20	A	US 4 548 997 A (MELLINGER ET AL) 22 October 1985 (1985-10-22) claims 1-7	1-20		----- -/--	
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.															
X	EP 0 594 386 A (GENERAL ELECTRIC COMPANY) 27 April 1994 (1994-04-27) page 6, line 59 - page 7, line 4; claim 1 page 9, line 22 - line 24	1-11, 13-20															
A	US 2001/016626 A1 (VOLLENBERG PETER HENDRIKUS THEODORUS ET AL) 23 August 2001 (2001-08-23) paragraph '0070!; claims 1,21	1-20															
A	US 4 548 997 A (MELLINGER ET AL) 22 October 1985 (1985-10-22) claims 1-7	1-20															
	----- -/--																
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.																	
* Special categories of cited documents : <table border="0"> <tr> <td style="vertical-align: top;"> <p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*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)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="vertical-align: top;"> <p>*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</p> <p>*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</p> <p>*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.</p> <p>*Z* document member of the same patent family</p> </td> </tr> </table>			<p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*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)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>*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</p> <p>*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</p> <p>*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.</p> <p>*Z* document member of the same patent family</p>													
<p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*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)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p>	<p>*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</p> <p>*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</p> <p>*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.</p> <p>*Z* document member of the same patent family</p>																
Date of the actual completion of the international search 12 October 2005		Date of mailing of the international search report 21/12/2005															
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Glanddier, A															

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/JP2005/022351

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>GUNDUZ ET AL.: "Glass filled polycarbonate ester-polyetherimide blends" ANNUAL TECHNICAL CONFERENCE - SOCIETY OF PLASTICS ENGINEERS, vol. 2, no. 61, 2003, pages 1842-1846, XP008053675 the whole document</p>	1-20

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2005/022351

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0594386	A	27-04-1994	CA 2108416 A1	24-04-1994
			DE 69333205 D1	23-10-2003
			DE 69333205 T2	05-08-2004
			JP 2954465 B2	27-09-1999
			JP 6200128 A	19-07-1994
			US 5387639 A	07-02-1995
US 2001016626	A1	23-08-2001	CN 1331711 A	16-01-2002
			EP 1124879 A1	22-08-2001
			JP 2004500442 T	08-01-2004
			WO 0026275 A1	11-05-2000
			US 2003216539 A1	20-11-2003
US 4548997	A	22-10-1985	NONE	