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(54) Title: FLAME-RETARDANT SCRATCH-RESISTANT THERMOPLASTIC RESIN COMPOSITION WITH IMPROVED COMPATIBILITY

(57) Abstract: Disclosed herein is a flame-retardant scratch-resistant thermoplastic resin composition comprising (A) about 20 to about 95 parts by weight of a polycarbonate resin; (B) about 1 to about 50 parts by weight of a copolymer resin comprising (B1) about 0 to about 100 % by weight of a rubber modified vinyl graft copolymer resin and (B2) about 0 to about 100 % by weight of a vinyl copolymer resin; (C) about 1 to about 50 parts by weight of a (meth)acrylic copolymer resin with a refractive index of about 1.50 to about 1.59; and (D) about 0.1 to about 40 parts by weight of a flame retardant, per 100 parts by weight of a base resin comprising (A) + (B) + (C).



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【DESCRIPTION】**【Invention Title】**

FLAME-RETARDANT SCRATCH-RESISTANT THERMOPLASTIC RESIN COMPOSITION WITH IMPROVED COMPATIBILITY

【Technical Field】

<1> The present invention relates to a flame-retardant scratch-resistant thermoplastic resin composition. More particularly, the present invention relates to a flame-retardant scratch-resistant thermoplastic resin composition having improved scratch resistance as well as compatibility by adding a (meth)acrylic copolymer resin with a high refractive index to a blend comprising a polycarbonate resin, a rubber modified vinyl graft copolymer and a vinyl copolymer.

<2>

【Background Art】

<3> Generally, thermoplastic resins have lower specific gravity than glasses and metals, and have good physical properties such as moldability and impact resistance. Recently, plastic products have rapidly replaced conventional glass or metal products and have been widely used in electrical and electronic goods, as large and light-weight, and economical products are becoming a widespread trend. Accordingly, as good appearance and function of the plastic products have become important when they are used in housings of electrical and electronic goods, there is a need for plastic materials which can provide scratch resistance to the exterior, impact resistance, and flame retardancy against fire.

<4> Polycarbonate resins, in particular, a blend of polycarbonate/vinyl copolymer (PC/ABS) have improved processability while maintaining high notch impact strength so that they have been widely used in the production of heat-emitting large-size injection molding products such as automobile parts, computer housings or office supplies, and the like. Further, polycarbonate resins can obtain good flame retardancy even with a non-hallogen flame

retardant, which allows environmentally friendly use. However, polycarbonate resins have a drawback of poor scratch resistance.

<5> On the other hand, although acrylate resins, especially, polymethylmethacrylate resins have good transparency, weatherability, mechanical strength, surface gloss, adhesive strength, and excellent scratch resistance, they have a disadvantage in that it is hard to obtain impact resistance and flame retardancy.

<6> In order to improve the scratch resistance of plastic products, a hard coating method, which includes the steps of coating a surface of an injection-molded resin with an organic-inorganic hybrid material and curing the organic-inorganic hybrid material on the surface of the resin using heat or ultra violet light, has been conventionally used. However, because the hard coating method requires an additional coating step, the processing time and the manufacturing cost increase and it may cause environmental problems. With recent increased interest in environmental protection and reduction of manufacturing costs, there is a need for a non-coated resin which has scratch resistance without using the hard coating method. Also, it is important to develop a resin with good scratch resistance for a housing manufacturing industry.

<7> One attempt to improve both scratch resistance and flame retardancy is to alloy polycarbonate/vinyl copolymer (PC/ABS) and acrylic resin, preferably polymethylmethacrylate (PMMA) to prepare a PC/ABS/PMMA resin. However, the method has a drawback in that it is difficult to obtain high transparency and colorability due to low compatibility and the differences between the refractive indices of the between polycarbonate resin and ABS and acrylic resin. It is also very difficult for an alloy of PC and PMMA to be used in housings of electrical and electronic products. Due to the different refractive indices of the PC resin and the PMMA resin (1.59 and 1.49, respectively), the alloy of PC resin and PMMA resin may scatter light. This makes it difficult to provide color with high chroma, and a melt joining line is clearly shown during extrusion.

<8> Korean Patent Publication Laid-open No. 2004-0079118 discloses a method of lowering the molecular weight of polycarbonate during a kneading process using metal stearic acid ester in order to improve the compatibility between a polycarbonate resin and a (meth)acrylate resin. However, the method has a disadvantage in that a blend of the polycarbonate and the methacrylate resin has significantly low mechanical properties.

<9> Accordingly, the present inventors have developed a flame-retardant scratch-resistant thermoplastic resin composition having good appearance and colorability as well as improved compatibility by applying a (meth)acrylic copolymer resin with a high refractive index to a blend comprising a polycarbonate resin, a rubber modified vinyl graft copolymer and a vinyl copolymer thereby reducing the difference between the of refractive indices of these resins.

<10>

【Disclosure】

【Technical Problem】

<11> An object of the present invention is to provide a flame-retardant scratch-resistant thermoplastic resin composition with improved compatibility.

<12> Another object of the present invention is to provides a flame-retardant scratch-resistant thermoplastic resin composition with a good balance of physical properties such as mechanical properties, scratch resistance, flame retardancy and the like.

<13> Another object of the present invention is to provides a flame-retardant scratch-resistant thermoplastic resin composition with good appearance and high colorability by minimizing deterioration of colorability between a polycarbonate resin and a (meth)acrylate resin.

<14> Another object of the present invention is to provides a flame-retardant scratch-resistant thermoplastic resin composition applicable for various articles such as parts of electrical and electronic goods, parts of automobiles, lenses, or window glasses, and the like, which need good

appearance and high colorability.

<15> Other aspects, features and advantages of the present invention will be apparent from the ensuing disclosure and appended claims.

<16>

【Technical Solution】

<17> An aspect of the present invention provides a flame-retardant scratch-resistant thermoplastic resin composition comprising (A) about 20 to about 95 parts by weight of a polycarbonate resin; (B) about 1 to about 50 parts by weight of a copolymer resin comprising (B1) about 0 to about 100 % by weight of a rubber modified vinyl graft copolymer resin and (B2) about 0 to about 100 % by weight of a vinyl copolymer resin; (C) about 1 to about 50 parts by weight of a (meth)acrylic copolymer resin with a refractive index of about 1.50 to about 1.59; and (D) about 0.1 to about 40 parts by weight of a flame retardant, per 100 parts by weight of a base resin comprising (A) + (B) + (C).

<18> In an exemplary embodiment, the flame-retardant scratch-resistant thermoplastic resin composition may comprise (A) about 50 to about 70 parts by weight of a polycarbonate resin; (B) about 10 to about 40 parts by weight of a copolymer resin comprising (B1) about 30 to about 70 % by weight of a rubber modified vinyl graft copolymer resin and (B2) about 30 to about 70 % by weight of a vinyl copolymer resin; and (C) about 5 to about 40 parts by weight of a (meth)acrylic copolymer resin with a refractive index of about 1.50 to about 1.59 and (D) about 10 to about 40 parts by weight of a flame retardant, per 100 parts by weight of a base resin comprising (A) + (B) + (C).

<19> The base resin may further comprise less than about 50 parts by weight of a (meth)acrylic resin (E). In an exemplary embodiment, the (meth)acrylic resin (E) may be used in an amount of about 1 to about 20 parts by weight.

<20> The rubber modified vinyl graft copolymer resin (B1) may be a copolymer or mixtures thereof obtained by graft-polymerizing about 50 to about 95 % by weight of an aromatic vinyl compound, C₁-C₈ (meth)acrylic acid alkyl ester

compound, or mixtures thereof, and about 5 to about 95 % by weight of vinyl cyanide compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, maleic anhydride, C₁-C₄ alkyl- or phenyl N-substituted maleimide, or mixtures thereof, onto about 5 to about 95 % by weight of rubbery polymer.

<21> The vinyl copolymer (B2) may be a copolymer or mixtures thereof comprising about 50 to about 95 % by weight of an aromatic vinyl compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, or mixtures thereof, and about 5 to about 50 % by weight of a vinyl cyanide compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, maleic anhydride, C₁-C₄ alkyl- or phenyl N-substituted maleimide, or mixtures thereof.

<22> The (meth)acrylic copolymer resin (C) may be a homopolymer or a copolymer of an aromatic or aliphatic methacrylate. In an exemplary embodiment, the (meth)acrylic copolymer resin (C) may be a copolymer of an aromatic or aliphatic methacrylate and a mono-functional unsaturated monomer.

<23> Preferably, the (meth)acrylic copolymer resin (C) may be a copolymer of about 20 to about 100 % by weight of an aromatic or aliphatic methacrylate and about 0 to about 80 % by weight of a mono-functional unsaturated monomer.

<24> The mono-functional unsaturated monomer may be at least one monomer selected from the group consisting of methacrylic acid ester monomers, acrylic acid ester monomers, acid anhydride monomers, hydroxyl group containing ester monomers, amide monomers, unsaturated nitrile monomers, allyl glycidyl ethers, glycidyl methacrylates, and aromatic vinyl compounds. In an exemplary embodiment, the mono-functional unsaturated monomer may be at least one monomer selected from the group consisting of methacrylic acid ester monomers including methyl methacrylate, ethyl methacrylate, propyl methacrylate, butyl methacrylate, phenyl methacrylate, phenoxyethyl methacrylate and benzyl methacrylate; acrylic acid ester monomers including methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, and 2-ethyl hexyl acrylate; unsaturated carboxylic acid monomers including acrylic acid and methacrylic acid; acid anhydride monomers including maleic anhydride;

hydroxyl group containing ester monomers including 2-hydroxyethyl acrylate, 2-hydroxypropyl acrylate, and monoglycerol acrylate; amide monomers including acryl amide and methacryl amide; nitrile monomers including acrylonitrile and methacrylonitrile; allyl glycidyl ethers; glycidyl methacrylates; and styrenic monomers including styrene and α -methyl styrene.

<25> The (meth)acrylic copolymer resin (C) may have a weight average molecular weight of about 5,000 to about 300,000.

<26> The flame retardant (D) may be at least one selected from phosphorus-containing flame retardants, halogen-containing flame retardants, and inorganic flame retardants.

<27> The (meth)acrylic resin (E) may be a (co)polymer of C_1 - C_8 alkyl (meth)acrylic monomers, or mixtures thereof.

<28> The thermoplastic resin composition may further comprise at least one additive selected from the group consisting of surfactants, nucleating agents, coupling agents, fillers, plasticizers, impact modifiers, antimicrobials, releasing agents, thermal stabilizers, antioxidants, light stabilizers, compatibilizers, inorganic fillers, coloring agents, stabilizers, lubricants, antistatic agents, pigments, dyes, flameproof agents, and the like. These additives may be used alone or in combination with one another.

<29> Another aspect of the present invention provides molded articles produced from the foregoing resin composition.

<30>

【Description of Drawings】

<31> FIG. 1(a) is a transmission electron microscope (TEM) image of a test specimen prepared in Example 5 and FIG. 1(b) is a transmission electron microscope (TEM) image of a test specimen prepared in Comparative Example 3.

<32> FIG. 2(a) is a scratch profile of a test specimen prepared in Example 1 and FIG. 2(b) is a scratch profile of a test specimen prepared in Comparative Example 1.

<33>

【Best Mode】**<34> (A) Polycarbonate Resin**

<35> The polycarbonate resin of the present invention may be prepared by any conventional method well known to those skilled in the art, that is, the polycarbonate resin may be prepared by reacting dihydric phenol compound with phosgene in the presence of a catalyst and a molecular weight controlling agent. Also, the polycarbonate resin may be prepared by transesterification of a carbonate precursor such as dihydric phenol compound and diphenylcarbonate.

<36> The dihydric phenol compound may be a bisphenol compound, preferably 2,2-bis(4-hydroxyphenyl)propane (bisphenol A). The bisphenol A may be partially or totally substituted with other dihydric phenol. In addition to bisphenol A, examples of dihydric phenols may include hydroquinone, 4,4'-dihydroxydiphenyl, bis(4-hydroxyphenyl)methane, 1,1-bis(4-hydroxyphenyl)cyclohexane, 2,2-bis(3,5-dimethyl-4-hydroxyphenyl)propane, bis(4-hydroxyphenyl)sulfide, bis(4-hydroxyphenyl)sulfone, bis(4-hydroxyphenyl)sulfoxide, bis(4-hydroxyphenyl)ketone, bis(4-hydroxyphenyl)ether, etc., and also include halogenated bisphenol such as 2,2-bis(3,5-dibromo-4-hydroxyphenyl)propane.

<37> However, the dihydric phenol compound applicable for preparing the polycarbonate resin is not limited to the aforementioned compounds, and any dihydric phenol compound may be used.

<38> Furthermore, the polycarbonate resin used in the present invention may be a homopolymer or a copolymer of two or more types of dihydric phenols, or a mixture thereof.

<39> Examples of polycarbonate resin in the present invention may also include, without limitation, linear polycarbonate resin, branched polycarbonate resin, polyester carbonate copolymer resin and the like.

<40> The linear polycarbonate resin may be, without limitation, a bisphenol A-based polycarbonate resin. The branched polycarbonate resin may be prepared by reacting poly-functional aromatic compounds such as trimellitic anhydride,

trimellitic acid, etc., with dihydric phenol compounds and carbonate precursors. The polyester carbonate copolymer resin may also be prepared, without limitation, by reacting di-functional carboxylic acid with dihydric phenol compounds and carbonate precursors. The linear polycarbonate resin, the branched polycarbonate resin and the polyester carbonate copolymer resin can be used alone or in combination with one another.

<41> In an exemplary embodiment, the polycarbonate resin may have a weight average molecular weight of about 10,000 to about 200,000 g/mol, preferably about 15,000 to about 80,000 g/mol, or about 20,000 to about 50,000 g/mol.

<42> According to the present invention, the polycarbonate resin may be used in an amount of about 20 to about 95 % by weight. Within those ranges, good mechanical properties and scratch resistance can be obtained. In an exemplary embodiment, the polycarbonate resin may be used in an amount of about 40 to about 90 % by weight, preferably about 45 to about 80 % by weight. In another exemplary embodiment, the polycarbonate resin may be used in an amount of about 51 to about 85 % by weight. In another exemplary embodiment, the polycarbonate resin may be used in an amount of about 85 to about 95 % by weight. In another exemplary embodiment, the polycarbonate resin may be used in an amount of about 30 to about 50 % by weight.

<43>

<44> **(B) Copolymer Resin**

<45> The copolymer resin (B) of the present invention constitutes a base resin, and may comprise (B1) about 0 to about 100 % by weight of a rubber modified vinyl graft copolymer resin and (B2) about 0 to about 100 % by weight of a vinyl copolymer resin. In an exemplary embodiment, the copolymer resin (B) may comprise (B1) about 10 to about 60 % by weight of a rubber modified vinyl graft copolymer resin and (B2) about 40 to about 90 % by weight of a vinyl copolymer resin. In another exemplary embodiment, the copolymer resin (B) may comprise (B1) about 51 to about 90 % by weight of a rubber modified vinyl graft copolymer resin and (B2) about 10 to about 49 % by weight of a vinyl copolymer resin. The copolymer resin (B) may be used in

an amount of about 1 to about 50 parts by weight, preferably about 10 to about 40 parts by weight, more preferably about 15 to about 30 parts by weight in the base resin.

<46>

<47> (B1) Rubber modified vinyl graft copolymer

<48> The rubber modified vinyl graft copolymer according to the present invention can be a copolymer or mixtures thereof obtained by graft-polymerizing about 50 to about 95 % by weight of an aromatic vinyl compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, or mixtures thereof, and about 5 to about 95 % by weight of vinyl cyanide compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, maleic anhydride, C₁-C₄ alkyl- or phenyl N-substituted maleimide, or mixtures thereof, onto about 5 to about 95 % by weight of rubbery polymer.

<49> In some exemplary embodiments, the rubber modified vinyl graft copolymer may be prepared by graft-polymerizing about 5 to about 95 % by weight of a monomer mixture comprising 50 to 95 % by weight of styrene, α -methylstyrene, halogen- or alkyl-substituted styrene, C₁-C₈ methacrylic acid alkyl ester, C₁-C₈ acrylic acid alkyl ester, or mixtures thereof, and about 5 to about 50 % by weight of acrylonitrile, methacrylonitrile, C₁-C₈ methacrylic acid alkyl ester, C₁-C₈ acrylic acid alkyl ester, maleic anhydride, C₁-C₄ alkyl- or phenyl N-substituted maleimide or mixtures thereof onto about 5 to about 95 % by weight of a rubbery polymer.

<50> The C₁-C₈ methacrylic acid alkyl ester or the C₁-C₈ acrylic acid alkyl ester can be prepared by the reaction of a monohydric alcohol containing 1 to 8 carbon atoms with an acrylic acid or a methacrylic acid respectively. Examples of suitable acid alkyl esters include methacrylic acid methyl ester, methacrylic acid ethyl ester, methacrylic acid propyl ester, acrylic acid methyl ester, acrylic acid ethyl ester, acrylic acid propyl ester, and the like.

<51> Examples of the rubbery polymer may include butadiene rubber, acrylic rubber, ethylene/propylene rubber, styrene/butadiene rubber, acrylonitrile/butadiene rubber, isoprene rubber, ethylene-propylene-diene terpolymer (EPDM), polyorganosiloxane/polyalkyl(meth)acrylate rubber complex, and the like. These rubbery polymers may be used alone or in combination with one another.

<52> In an exemplary embodiment, the rubber modified vinyl graft copolymer (B1) may be a copolymer prepared by graft-copolymerizing a monomer mixture comprising styrene, acrylonitrile, and selectively a (meth)acrylic acid alkyl ester, onto a butadiene rubber, acrylic rubber or styrene/butadiene rubber.

<53> In another exemplary embodiment, the rubber modified vinyl graft copolymer (B1) may be a copolymer prepared by graft-copolymerizing a (meth)acrylic acid methyl ester onto a butadiene rubber, acrylic rubber or styrene/butadiene rubber.

<54> The most preferable graft copolymer in the present invention is an ABS graft copolymer.

<55> The rubber polymer may have an average particle size of about 0.05~4 μm , which can be useful to improve the impact resistance and the appearance of a molded article.

<56> The graft copolymer can be prepared through a conventional polymerization process such as emulsion polymerization, suspension polymerization, solution polymerization, or bulk polymerization. Among these processes, emulsion or bulk polymerization can be useful, in which the vinyl monomers are added to the rubber polymer using an initiator.

<57>

<58> (B2) Vinyl Copolymer

<59> The vinyl copolymer (B2) of the present invention can be a copolymer or mixtures thereof comprising about 50 to about 95 % by weight of an aromatic vinyl compound, $\text{C}_1\text{-C}_8$ (meth)acrylic acid alkyl ester compound, or mixtures thereof, and about 5 to about 50 % by weight of vinyl cyanide compound, $\text{C}_1\text{-C}_8$

(meth)acrylic acid alkyl ester compound, maleic anhydride, C₁-C₄ alkyl- or phenyl N-substituted maleimide, or mixtures thereof.

<60> In an exemplary embodiment, the vinyl copolymer (B2) of the present invention can be a copolymer or mixtures thereof prepared by copolymerizing about 50 to about 95 % by weight of styrene, α -methylstyrene, halogen- or alkyl-substituted styrene, C₁-C₈ methacrylic acid alkyl ester, C₁-C₈ acrylic acid alkyl ester, or mixtures thereof, and about 5 to about 50 % by weight of acrylonitrile, methacrylonitrile, C₁-C₈ methacrylic acid alkyl ester, C₁-C₈ acrylic acid alkyl ester, maleic anhydride, and C₁-C₄ alkyl- or phenyl N-substituted maleimide or mixtures thereof.

<61> The C₁-C₈ methacrylic acid alkyl ester or the C₁-C₈ acrylic acid alkyl ester can be prepared by the reaction of a monohydric alcohol containing 1 to 8 carbon atoms with an acrylic acid or a methacrylic acid respectively. Examples of suitable acid alkyl esters include methacrylic acid methyl ester, methacrylic acid ethyl ester, acrylic acid methyl ester, acrylic acid ethyl ester, acrylic acid propyl ester, methacrylic acid propyl ester, and the like.

<62> The vinyl copolymer (B2) can be produced as by-products when preparing the rubber modified vinyl graft copolymer (B1). The by-products are mostly produced when a large quantity of monomers are grafted onto a small amount of rubber polymer or when a chain transfer agent is used in excess. The amount of the vinyl copolymer (B2) to be used in this invention does not include the amount of the by-products that might be produced during preparation of the rubber modified vinyl graft copolymer (B1).

<63> Examples of suitable vinyl copolymer (B2) can include those prepared from a monomer mixture of styrene, acrylonitrile, and optionally methacrylic acid methyl ester; a monomer mixture of α -methyl styrene, acrylonitrile, and optionally methacrylic acid methyl ester; or a monomer mixture of styrene, α -methyl styrene acrylonitrile, and optionally methacrylic acid methyl ester.

<64> The vinyl copolymer can be prepared by an emulsion, suspension, solution, or bulk process, and can have a weight average molecular weight (M_w) of about 15,000 to about 200,000.

<65> Other examples of suitable vinyl copolymers (B2) can include those prepared from a mixture of methacrylic acid methyl ester monomers and optionally acrylic acid methyl ester monomers or acrylic acid ethyl ester monomers. The methacrylic acid methyl ester polymer can be prepared by an emulsion, suspension, solution or bulk process, and can have a weight average molecular weight (M_w) of about 20,000 to about 250,000.

<66> Yet another suitable vinyl copolymer (B2) can include a copolymer of styrene and maleic anhydride, which can be prepared by a continuous bulk process and a solution process. The maleic anhydride can be used in the amount of about 5 to about 50 % by weight. The copolymer of styrene and maleic anhydride can have a weight average molecular weight (M_w) of about 20,000 to about 200,000 and an intrinsic viscosity of about 0.3 to about 0.9 dl/g.

<67> The styrene monomer for preparation of the vinyl copolymers (B2) in this invention can be replaced by p-methylstyrene, vinyltoluene, 2,4-dimethylstyrene, or α -methylstyrene.

<68>

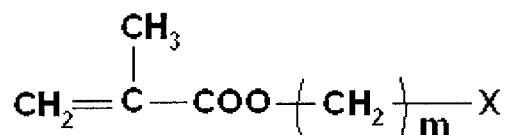
<69> (C) (Meth)acrylic Copolymer Resin

<70> The (meth)acrylic copolymer resin (C) may be a homopolymer or a copolymer of aromatic or aliphatic methacrylates. In an exemplary embodiment, the (meth)acrylic copolymer resin (C) may be a copolymer of an aromatic or aliphatic methacrylate and a mono-functional unsaturated monomer.

<71> The aromatic or aliphatic methacrylate may be represented by the following Chemical Formula 1 or Chemical Formula 2.

<72>

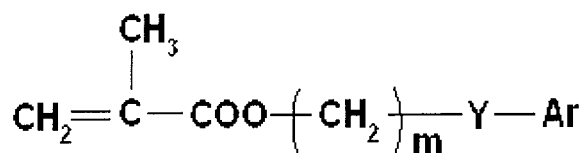
<73> [Chemical Formula 1]



<74>
<75> (wherein m is an integer from 0 to 10, and X is selected from the group consisting of a cyclohexyl group, a phenyl group, a methylphenyl group, a methylethylphenyl group, a methoxyphenyl group, a cyclohexylphenyl group, a chlorophenyl group, a bromophenyl group, phenylphenyl group, and benzylphenyl group.)

<76>

<77> [Chemical Formula 2]



<78>
<79> (wherein m is an integer from 0 to 10, Y is oxygen(O) or sulfur(S), and Ar is selected from the group consisting of a cyclohexyl group, a phenyl group, a methylphenyl group, a methylethylphenyl group, a methoxyphenyl group, a cyclohexylphenyl group, a chlorophenyl group, a bromophenyl group, phenylphenyl group, and benzylphenyl group.)

<80>

<81> Examples of the aromatic or aliphatic methacrylate may include, but are not limited to, cyclohexyl methacrylate, 2-ethylphenoxy methacrylate, 2-ethylthiophenyl methacrylate, 2-ethylaminophenyl methacrylate, phenyl methacrylate, benzyl methacrylate, 2-phenylethyl methacrylate, 3-phenylpropyl methacrylate, 4-phenylbutyl methacrylate, 2-2-methylphenylethyl methacrylate, 2-3-methylphenylethyl methacrylate, 2-4-methylphenylethyl methacrylate, 2-(4-propylphenyl)ethyl methacrylate, 2-(4-(1-methylethyl)phenyl)ethyl methacrylate, 2-(4-methoxyphenyl)ethyl methacrylate, 2-(4-cyclohexylphenyl)ethyl methacrylate, 2-(2-chlorophenyl)ethyl methacrylate, 2-(3-chlorophenyl)ethyl methacrylate, 2-(4-chlorophenyl)ethyl

methacrylate, 2-(4-bromophenyl)ethyl methacrylate, 2-(3-phenylphenyl)ethyl methacrylate, and 2-(4-benzylphenyl)ethyl methacrylate. These are used alone or in combination with one another.

<82> The mono-functional unsaturated monomers may be, without limitation, (meth)acrylic acid esters, acrylic acid esters; acid anhydrides; hydroxyl group containing esters; amides; unsaturated nitriles; allyl glycidyl ethers; glycidyl methacrylates; aromatic vinyl monomers, and the like. In some exemplary embodiments, the mono-functional unsaturated monomer may be methacrylic acid ester monomers including ethyl methacrylate, propyl methacrylate, butyl methacrylate and benzyl methacrylate; acrylic acid ester monomers including methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, and 2-ethyl hexyl acrylate; unsaturated carboxylic acid monomers including acrylic acid and methacrylic acid; acid anhydride monomers including maleic anhydride; hydroxyl group containing ester monomers including 2-hydroxyethyl acrylate, 2-hydroxypropyl acrylate, and monoglycerol acrylate; amide monomers including acryl amide and methacryl amide; nitrile monomers including acrylonitrile and methacrylonitrile; allyl glycidyl ethers; glycidyl methacrylates; styrenic monomers including styrene and α -methyl styrene, and the like. These may be used alone or in combination with one another.

<83> In an exemplary embodiment, the (meth)acrylic copolymer resin (C) may be prepared by copolymerizing about 20 to about 100 % by weight of the aromatic or aliphatic methacrylate and about 0 to about 80 % by weight of the mono-functional unsaturated monomer. If the amount of the aromatic or aliphatic methacrylate is less than 20 % by weight, the (meth)acrylic copolymer resin may have an average refractive index of less than about 1.50. In another exemplary embodiment, the (meth)acrylic copolymer resin (C) may be prepared by copolymerizing about 50 to about 90 % by weight of the aromatic or aliphatic methacrylate and about 10 to about 50 % by weight of the mono-functional unsaturated monomer. In other exemplary embodiment, the (meth)acrylic copolymer resin (C) may be prepared by copolymerizing about 60

to about 80 % by weight of the aromatic or aliphatic methacrylate and about 20 to about 40 % by weight of the mono-functional unsaturated monomer.

<84> The (meth)acrylic copolymer resin may be prepared by conventional methods such as bulk polymerization, emulsion polymerization, and suspension polymerization.

<85> The (meth)acrylic copolymer resin (C) of the present invention has a higher refractive index than that of conventional (meth)acrylic copolymers. The (meth)acrylic copolymer resin with high refractive index may be prepared to have a refractive index of about 1.50 to 1.59, whereas conventional polycarbonate resins have a refractive index of about 1.59 and polymethylmethacrylate has a refractive index of about 1.49. In an exemplary embodiment, the (meth)acrylic copolymer resin (C) may have a refractive index of about 1.52 to 1.58, while in some exemplary embodiments, the (meth)acrylic copolymer resin may have a refractive index of about 1.53 to about 1.575.

<86> As the (meth)acrylic copolymer resin (C) of the present invention may have a high refractive index, thereby decreasing the difference of refractive index from the refractive index of the polycarbonate resin, it is possible to obtain a resin composition having good transparency, when it is blended with polycarbonate resin.

<87> When a mixture of the (meth)acrylic copolymer resin (C) and the (meth)acrylic resin (E) is blended with the polycarbonate resin (A), the difference between the refractive index of the (meth)acrylic resin (E) and the refractive index of the polycarbonate may be lowered due to the increased refractive index of the (meth)acrylic copolymer resin (C). Therefore, it is possible to prevent the deterioration of transparency and colorability usually occurring in a conventional mixture of the (meth)acrylic resin (E) and a polycarbonate resin (A) due to the difference between the refractive index of the two resins.

<88> The (meth)acrylic copolymer resin (C) may have a weight average molecular weight of about 5,000 to about 300,000. In an exemplary embodiment, the (meth)acrylic copolymer resin (C) may have a weight average molecular

weight of about 100,000 to about 250,000 or about 110,000 to about 200,000.

In another exemplary embodiment, the (meth)acrylic copolymer resin (C) may have a weight average molecular weight of about 10,000 to about 70,000 g/mol.

In another exemplary embodiment, the (meth)acrylic copolymer resin (C) may have a weight average molecular weight of about 5,000 to about 10,000 g/mol.

<89> The (meth)acrylic copolymer resin (C) may be used in an amount of about 1 to about 50 parts by weight, preferably about 5 to about 40 parts by weight, more preferably about 10 to about 35 parts by weight.

<90>

<91> (D) Flame retardant

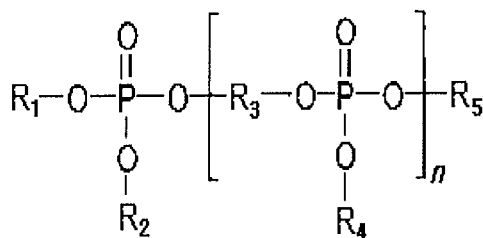
<92> The flame retardant of the present invention may be at least one selected from phosphorus-containing flame retardants, halogen-containing flame retardants, and inorganic flame retardants, without limitation.

<93> In an exemplary embodiment, the flame retardant may be a phosphorus-containing flame retardant. Examples of the phosphorus-containing flame retardants may include, but are not limited to, phosphate, phosphonate, phosphinate, phosphine oxide, phosphazene, a metal salt thereof, and the like.

<94> The phosphate may be an aromatic phosphoric ester compound represented by the following Chemical Formula 3.

<95>

<96> [Chemical Formula 3]



<97>

<98> (wherein R₁, R₂, R₄, and R₅ are independently C₆~C₂₀ aryl group or C₁~C₁₂ alkyl substituted aryl group; R₃ is a derivative of dialcohols such as resorcinol, hydroquinol, bisphenol-A, bisphenol-S and the like; and n is

about 0~5.)

<99> Preferably, R_1 , R_2 , R_4 , and R_5 are independently a phenyl group or a phenyl group substituted with an alkyl group such as methyl, ethyl, isopropyl, t-butyl, isobutyl, isoamyl, t-amyl, etc. More preferably, R_1 , R_2 , R_4 , and R_5 are independently a phenyl group or a phenyl group substituted with methyl, ethyl, isopropyl, or t-butyl.

<100> In an exemplary embodiment, the aromatic phosphoric ester compound represented by the Chemical Formula 3 may be a monomer or oligomer having an average value of n of about 0~3. In an exemplary embodiment, a phosphoric ester compound having n of 0, 1, 2, and 3 can be used alone or in combination with one another.

<101> In another exemplary embodiment, the aromatic phosphoric ester compound may be used in combination with other phosphorus-containing flame retardants.

<102> In another exemplary embodiment, the flame retardant may be a conventional halogen-containing flame retardant. Examples of the halogen-containing flame retardant may include, without limitation, decabromo diphenylether, decabromo diphenylethane, tetrabromo bisphenol A, tetrabromo bisphenol A-epoxy oligomer, octabromo trimethylphenyl phosphate, ethylene bistetrabromophthalimide, tris (tribromophenol)triazine, brominated polystyrene, and the like. In some exemplary embodiments, a halogen-containing compound which is able to melt at conventional process temperatures, for example, a halogen-containing compound having a melting point or a softening point under about 250 °C may be preferred.

<103> In some exemplary embodiments, when the halogen-containing compound is applied, inorganic compounds such as antimony trioxide and antimony pentoxide may be used together depending on its use.

<104> The flame retardant (D) may be used in amount of about 0.1 to about 40 parts by weight, preferably about 1 to about 30 parts by weight, more preferably about 10 to about 25 parts by weight, per 100 parts by weight of a base resin.

<105>

<106> (E) (Meth)acrylic resin

<107> The resin composition of the present invention may optionally further comprise a (meth)acrylic resin (E). The (meth)acrylic resin (E) may be a polymer or a copolymer of one or more of C₁₋₈ alkyl (meth)acrylic monomers, or a mixture thereof. In addition, the (meth)acrylic resin may have a linear structure.

<108> Examples of the (meth)acrylic monomer may include, but are not limited to, methyl methacrylate, ethyl methacrylate, n-propyl methacrylate, n-butyl methacrylate, methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, 2-ethylhexyl acrylate, 2-ethylhexyl methacrylate, and the like. These (meth)acrylic monomers may be used alone or in combination with one another.

<109> The (meth)acrylic resin (E) may be prepared by conventional methods such as bulk polymerization, emulsion polymerization, and suspension polymerization.

<110> Further, the (meth)acrylic resin may be a homopolymer or a copolymer of two types or more of (meth)acrylic monomers, or mixtures thereof.

<111> The (meth)acrylic resin (E) may be used in an amount of about 50 parts by weight or less, which may be added to (A) polycarbonate resin, (B) copolymer resin, and (C) (meth)acrylic copolymer resin. In an exemplary embodiment, the (meth)acrylic resin (E) may be used in an amount of about 1 to about 35 parts by weight. In another exemplary embodiment, the (meth)acrylic resin (E) may be used in an amount of about 5 to about 20 parts by weight.

<112> The thermoplastic resin composition may further comprise additives such as surfactants, nucleating agents, coupling agents, fillers, plasticizers, impact modifiers, antimicrobials, releasing agents, thermal stabilizers, antioxidants, light stabilizers, compatibilizer, inorganic fillers, coloring agents, stabilizers, lubricants, antistatic agents, pigments, dyes, flameproof agents, and the like. These additives may be used alone or in

combination with one another.

<113> The resin composition of the present invention may be prepared by conventional methods. For example, the aforementioned components and other additives may be mixed in a mixer together and the mixture may be melt-extruded through a conventional extruder in a pellet form, and then the resin pellets may be used to prepare plastic molded articles by injection and extrusion.

<114> Since the thermoplastic resin composition has excellent scratch resistance, colorability, and transparency, the thermoplastic resin composition may be molded into various articles such as housings or parts of electrical and electronic goods, parts of automobiles, lenses, window glasses, and the like.

<115> In some exemplary embodiments, the scratch-resistant thermoplastic resin composition may be used in housings of electrical and electronic products such as TV, audio sets, washing machines, cassette players, MP3, telephones, game devices, video players, computers, photocopiers, and the like.

<116> In another exemplary embodiment, the scratch-resistant thermoplastic resin composition may be used for internal or external parts of automobiles such as dashboard panels, instrumental panels, door panels, quarter panels, wheel covers, and the like.

<117> The molding methods may be, but are not limited to, extrusion, injection, or casting molding, and may be easily carried out by those skilled in the art.

<118>

<119> The invention may be better understood by reference to the following examples which are intended for the purpose of illustration and are not to be construed as in any way limiting the scope of the present invention, which is defined in the claims appended hereto.

<120>

【Mode for Invention】

<121> Example

<122>

<123> (A) Polycarbonate resin

<124> Bisphenol-A linear polycarbonate with a weight average molecular weight of 25,000 (Mw) manufactured by Teijin Chemicals Ltd. of Japan (product name: PANLITE L-1250 WP) was used.

<125>

<126> (B) Copolymer resin

<127> (B1) ABS graft copolymer resin

<128> 45 parts of polybutadiene rubber latex (solid content), 39 parts by weight of styrene, 16 parts by weight of acrylonitrile and 150 parts by weight of deionized water were mixed. To the mixture, 1.0 part by weight of potassium oleate, 0.4 parts by weight of cumenhydroperoxide, and 0.3 parts by weight of t-dodecyl mercaptan chain transfer agent were added. The blend was kept at 75 °C for 5 hours to obtain an ABS graft copolymer (g-ABS) latex. To the g-ABS latex, 1 % sulfuric acid solution was added, coagulated and dried to obtain a graft copolymer resin (g-ABS) in powder form.

<129>

<130> (B2) SAN copolymer resin

<131> 76 parts by weight of styrene, 24 parts by weight of acrylonitrile, and 120 parts of deionized water were mixed. To the mixture, 0.17 parts by weight of azobisisobutyronitrile (AIBN), 0.4 parts by weight of t-dodecyl mercaptan chain transfer agent, and 0.5 parts by weight of tricalciumphosphate were added. The mixture was suspension polymerized at 75 °C for 5 hours, and a styrene-acrylonitrile (SAN) copolymer resin was obtained. The resultant copolymer was washed, dehydrated and dried to obtain SAN copolymer resin having a weight average molecular weight of 150,000 g/mol in powder form.

<132>

<133> (C) (Meth)acrylic copolymer resin with high refractive index

<134> (C1) (Meth)acrylic copolymer with high refractive index-1

<135> The (meth)acrylic copolymer with high refractive index was prepared by

suspension polymerizing 30 parts by weight of a methylmethacrylate monomer and 70 parts by weight of phenyl methacrylate with a refractive index of 1.570. The resulting copolymer has a refractive index of 1.546 and a weight average molecular weight of 120,000 g/mol.

<136>

<137> (C2) (Meth)acrylic copolymer with high refractive index-2

<138> The (meth)acrylic copolymer with high refractive index was prepared by suspension polymerizing 50 parts by weight of a methylmethacrylate monomer and 50 parts by weight of phenyl methacrylate with a refractive index of 1.570. The resulting copolymer has a refractive index of 1.530 and a weight average molecular weight of 120,000 g/mol.

<139>

<140> (D) Flame retardant

<141> Bisphenol A diphosphate manufactured by Daihachi Chemical Industry Co., Ltd. of Japan (product name: CR-741) was used.

<142>

<143> (E) (Meth)acrylic resin

<144> Polymethylmethacrylate resin with a weight average molecular weight of 92,000 (Mw) manufactured by LG MMA Ltd. of South Korea (product name: L84) was used.

<145>

<146> Examples 1~5

<147> The components as shown in Table 1 were added to a conventional mixer, and the mixture was extruded through a conventional twin screw extruder (L/D=29, Φ =45 mm) to prepare a product in pellet form. The pellets were dried at 80 °C for 6 hours and then molded into test specimens using 6 Oz injection molding machine.

<148>

<149> Comparative Examples 1~3

<150> Comparative Example 1 was conducted in the same manner as in the Example 1 except that the (meth)acrylic copolymer resin (C) of the present

invention was not used.

<151> Comparative Example 2 was conducted in the same manner as in the Example 1 except that (meth)acrylic resin (E) instead of the (meth)acrylic copolymer resin (C) was used.

<152> Comparative Example 3 was conducted in the same manner as in the Example 5 except that (meth)acrylic resin (E) instead of the (meth)acrylic copolymer resin (C) was used.

<153>

<154> The improved compatibility was confirmed by phase separation behavior through TEM images. The test specimen with dimensions of L 90 mm $\times$ W 50 mm $\times$ T 2.5 mm was used for measuring the above appearance properties. On the other hand, in order to analyze phase division behavior, TEM images of resin compositions of Example 5 and Comparative Example 3 were respectively shown in FIGS. 1(a) and 1(b). Although Comparative Example 3 exhibits a polymethylmethacrylate continuous phase and large domain in a polycarbonate base due to lowered compatibility, Example 5 exhibits improved compatibility since phase division of polymethylmethacrylate is not shown and homogenous phase with polycarbonate is shown.

<155>

<156> (1) The compatibility and the transparency of the resin composition were estimated by measuring flow mark, transparency, color and transmittance. The flow mark, transparency and color appeared on the test specimen were measured by naked eyes.

<157> (2) Flexural Modulus: The flexural modulus was measured in accordance with ASTM D790.

<158> (3) Flame Retardancy: The flame retardancy was measured in accordance with UL 94V using a 2.5 mm thick test specimen.

<159> (4) Scratch resistance: The scratch resistance was measured by ball-type scratch profile (BSP) test. The BSP was conducted by applying a scratch of a length of 10 to 20 mm onto resin specimens with dimensions of L 90 mm $\times$ W 50 mm $\times$ T 2.5 mm at load of 1,000 g and a scratch speed of 75

mm/min, using a metal spherical tip with a diameter of 0.7 mm and measuring a profile of the applied scratch through a surface profile analyzer (XP-I) manufactured by Ambios Corporation which provides a scratch profile through surface scanning using a metal stylus tip with a diameter of 1~2 μm . The scratch resistance was evaluated from a scratch width by the measured profile.

<160> FIG. 2(a) was a scratch profile picture of a test specimen prepared in Example 1 measured by BSP test, and FIG 2(b) was a scratch profile picture of a test specimen prepared in Comparative Example 1.

<161>

<162> **【Table 1】**

		Examples					Comparative Examples		
		1	2	3	4	5	1	2	3
(A)PC		58.4	58.4	58.4	58.4	51.1	73	58.4	51.1
(B)	(B1)ABS	11.2	11.2	11.2	11.2	9.8	14	11.2	9.8
	(B2)SAN	10.4	10.4	10.4	10.4	9.1	13	10.4	9.1
(C)	(C1)	20	-	10	-	30	-	-	-
	(C2)	-	20	-	10	-	-	-	-
(D)Flame Retardant		18	18	18	18	18	18	18	18
(E)Acrylic Resin		-	-	10	10	-	-	20	30
Flow Mark		X	X	X	X	X	X	O	O
Color(Opaque Milky presence)		white	white	white	white	white	white	Opaque milky	Opaque milky
Flexural Modulus		26010	25970	25835	25660	26570	25130	25470	25730
Flame Retardancy	UL94 (2.5mm)	V0	V0	V0	V0	V0	V0	V0	V0
BSP	Width (μm)	292	290	288	286	277	316	289	275

<163>

<164>

<165> As shown in Table 1, the resin compositions in Examples 1 to 5 and Comparative Examples 2~3 employing (meth)acrylic copolymer resin (C) or (meth)acrylic resin (E) exhibit improved scratch resistance as compared with Comparative Example 1, which is also confirmed by the scratch profile (FIG. 2). With respect to flame retardancy, all resin compositions exhibit flame retardancy of V0 or V1 measured in accordance with UL94.

<166> Although Comparative Examples 2 and 3 in which (meth)acrylic resin (E) was used instead of (meth)acrylic copolymer resin (C) show better scratch resistance than Comparative Example 1 using neither (meth)acrylic resin (E) nor (meth)acrylic copolymer resin (C), they show flow mark and opaque appearance due to low compatibility between the resins. The resin compositions in Examples 1 to 5 using the (meth)acrylic copolymer resin (C) do not exhibit flow mark or Opaque Milky appearance due to improved compatibility and refractive index. Thus, good appearance as well as high colorability can be obtained.

<167> Further, Example 1 using (meth)acrylic copolymer resin (C) with higher refractive index exhibits better compatibility compared to Example 2. Although resin compositions not using the (meth)acrylic resin (E) exhibit better compatibility compared to the resin compositions using both (meth)acrylic copolymer resin (C) and (meth)acrylic resin (E), the resin compositions in Examples 3 to 4 using (meth)acrylic copolymer resin (C) and (meth)acrylic resin (E) together also show improved compatibility, because average refractive index of (meth)acrylic resin is increased.

<168>

<169> In the above, the present invention was described based on the specific preferred embodiments, but it should be apparent to those ordinarily skilled in the art that various changes and modifications can be added without departing from the spirit and scope of the present invention which will be defined in the appended claims.

【CLAIMS】**【Claim 1】**

<171> A flame-retardant scratch-resistant thermoplastic resin composition comprising:

<172> (A) about 20 to about 95 parts by weight of a polycarbonate resin;

<173> (B) about 1 to about 50 parts by weight of a copolymer resin comprising (B1) about 0 to about 100 % by weight of a rubber modified vinyl graft copolymer resin and (B2) about 0 to about 100 % by weight of a vinyl copolymer resin;

<174> (C) about 1 to about 50 parts by weight of a (meth)acrylic copolymer resin with a refractive index of about 1.50 to about 1.59; and

<175> (D) about 0.1 to about 40 parts by weight of a flame retardant, per 100 parts by weight of a base resin comprising (A) + (B) + (C).

<176>

【Claim 2】

<177> The thermoplastic resin composition of Claim 1, wherein said base resin further comprises less than about 50 parts by weight of a (meth)acrylic resin (E).

<178>

【Claim 3】

<179> The thermoplastic resin composition of Claim 1, wherein said rubber modified vinyl graft copolymer resin (B1) is a copolymer or mixtures thereof obtained by graft polymerizing about 50 to about 95 % by weight of an aromatic vinyl compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, or mixtures thereof and about 5 to about 95 % by weight of a vinyl cyanide compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, maleic anhydride, C₁-C₄ alkyl- or phenyl N-substituted maleimide, or mixtures thereof, onto about 5 to about 95 % by weight of rubbery polymer.

<180>

【Claim 4】

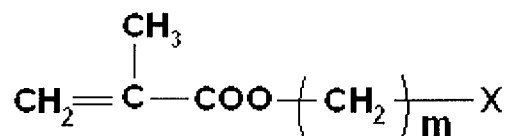
<181> The thermoplastic resin composition of Claim 1, wherein said vinyl copolymer (B2) is a copolymer or mixtures thereof comprising about 50 to about 95 % by weight of an aromatic vinyl compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, or mixtures thereof, and about 5 to about 50 % by weight of a vinyl cyanide compound, C₁-C₈ (meth)acrylic acid alkyl ester compound, maleic anhydride, C₁-C₄ alkyl- or phenyl N-substituted maleimide, or mixtures thereof.

<182>

【Claim 5】

<183> The thermoplastic resin composition of Claim 1, wherein said (meth)acrylic copolymer resin (C) comprises about 20 to about 100 % by weight of an aromatic or aliphatic methacrylate represented by the following Chemical Formula 1 or Chemical Formula 2 and about 0 to about 80 % by weight of a mono-functional unsaturated monomer:

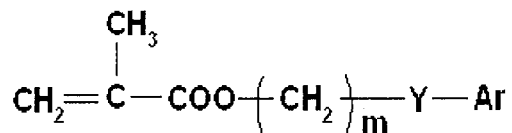
<184> [Chemical Formula 1]



<185>

<186> (wherein m is an integer from 0 to 10, and X is selected from the group consisting of a cyclohexyl group, a phenyl group, a methylphenyl group, a methylethylphenyl group, a methoxyphenyl group, a cyclohexylphenyl group, a chlorophenyl group, a bromophenyl group, phenylphenyl group, and benzylphenyl group);

<187> [Chemical Formula 2]



<188>

<189> (wherein m is an integer from 0 to 10, Y is oxygen(O) or sulfur(S), and Ar is selected from the group consisting of a cyclohexyl group, a phenyl group, a methylphenyl group, a methylethylphenyl group, a methoxyphenyl

group, a cyclohexylphenyl group, a chlorophenyl group, a bromophenyl group, phenylphenyl group, and benzylphenyl group).

<190>

【Claim 6】

<191>

The thermoplastic resin composition of Claim 5, wherein said mono-functional unsaturated monomer is at least one monomer selected from the group consisting of methacrylic acid ester monomers including methyl methacrylate, ethyl methacrylate, propyl methacrylate, butyl methacrylate, phenyl methacrylate, phenoxyethyl methacrylate and benzyl methacrylate; acrylic acid ester monomers including methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, and 2-ethyl hexyl acrylate; unsaturated carboxylic acid monomers including acrylic acid and methacrylic acid; acid anhydride monomers including maleic anhydride; hydroxyl group containing ester monomers including 2-hydroxyethyl acrylate, 2-hydroxypropyl acrylate, and monoglycerol acrylate; amide monomers including acryl amide and methacryl amide; nitrile monomers including acrylonitrile and methacrylonitrile; allyl glycidyl ethers; glycidyl methacrylates; and styrenic monomers including styrene and α -methyl styrene.

<192>

【Claim 7】

<193>

The thermoplastic resin composition of Claim 1, wherein said (meth)acrylic copolymer resin (C) has a weight average molecular weight of about 5,000 to about 300,000.

<194>

【Claim 8】

<195>

The thermoplastic resin composition of Claim 1, wherein said flame retardant (D) is at least one flame retardant selected from a phosphorus-containing flame retardant, a halogen-containing flame retardant, and an inorganic flame retardant.

<196>

【Claim 9】

<197> The thermoplastic resin composition of Claim 2, wherein said (meth)acrylic resin (E) is a (co)polymer of (meth)acrylic monomers, or mixtures thereof selected from the group consisting of methyl methacrylate, ethyl methacrylate, n-propyl methacrylate, n-butyl methacrylate, methyl acrylate, ethyl acrylate, propyl acrylate, butyl acrylate, 2-ethylhexyl acrylate, 2-ethylhexyl methacrylate, and mixtures thereof.

<198>

【Claim 10】

<199> The thermoplastic resin composition of Claim 1, wherein said resin composition further comprises at least one additive selected from the group consisting of surfactants, nucleating agents, coupling agents, fillers, plasticizers, impact modifiers, antimicrobials, releasing agents, thermal stabilizers, antioxidants, light stabilizers, compatibilizers, inorganic fillers, coloring agents, stabilizers, lubricants, antistatic agents, pigments, dyes, and flameproof agents.

<200>

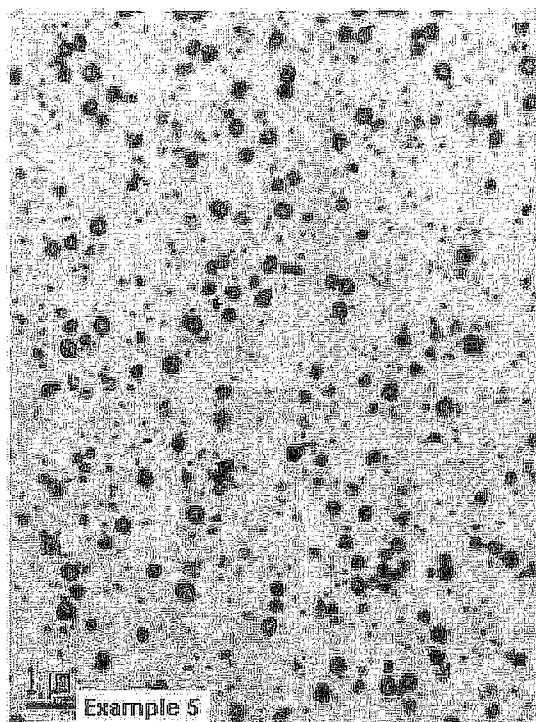
【Claim 11】

<201> A molded article produced from the resin composition as defined in any one of Claims 1~10.

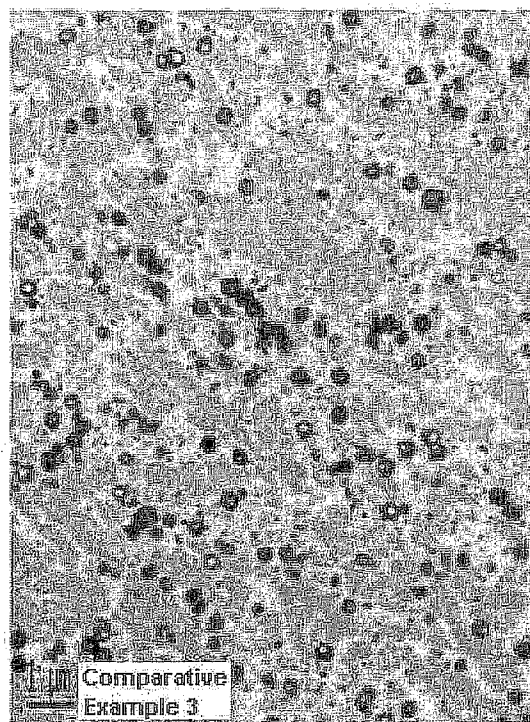
【DRAWINGS】

【Figure 1】

(a)

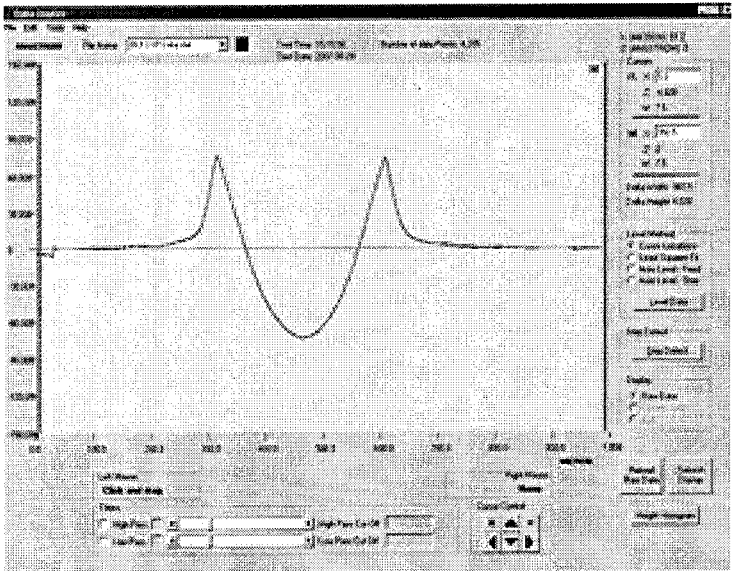


(b)

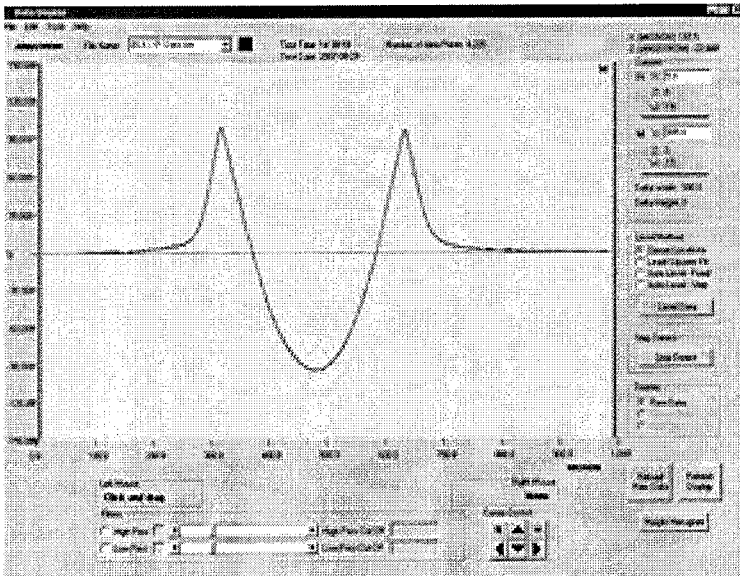


【Figure 2】

(a)



(b)



A. CLASSIFICATION OF SUBJECT MATTER*C08L 69/00(2006.01)i*

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)

IPC 8: C08L 69/00

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 practicable, search terms used)

eKOMPASS(KIPO internal), PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP2006-257284 A (TEIJIN CHEM LTD) 28 Sep. 2006 Claims 1-8; Par [74], [127]-[129], [153]-[154], [161]	1-11
Y	JP2001-049072 A (TEIJIN CHEM LTD) 20 Feb. 2001 Claims 1-3; Par. [6]-[8], [52]-[57], [67]	1-11
A	JP04-023856 A (ASAHI CHEM IND CO LTD) 28 Jan. 1992 Whole document	1-11
A	JP04-359954 A (ASAHI CHEM IND CO LTD) 14 Dec. 1992 Whole document	1-11
A	JP06-313089 A (KURARAY CO LTD) 08 Nov. 1994 Whole document	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

17 AUGUST 2009 (17.08.2009)

Date of mailing of the international search report

18 AUGUST 2009 (18.08.2009)

Name and mailing address of the ISA/KR

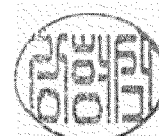
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gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

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Telephone No. 82-42-481-5597



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/007838Patent document
cited in search reportPublication
datePatent family
member(s)Publication
date

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None

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None

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None

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None