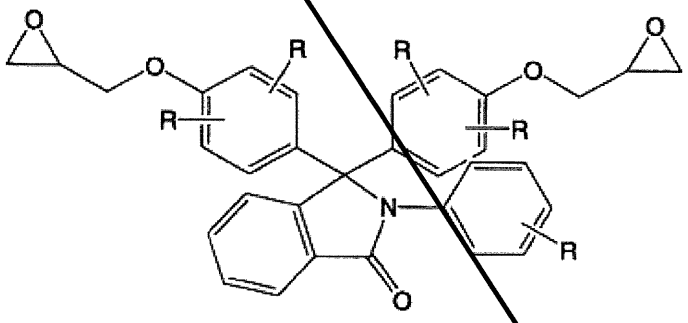
[0021]

(In the formula, each of plurally existent Rs independently represents a hydrogen atom, an alkyl group having from 1 to 6 carbon atoms, or an alkoxy group having from 1 to 6 carbon atoms.)

[0022]

In addition, the second aspect of the present invention (hereinafter also referred to as "second invention") is concerned with a curable resin composition containing an epoxy resin represented by the following formula (2) and a phenol resin and/or a polymerization catalyst.

[0023]



(2)

[0024]

(In the formula, each of plurally existent Rs independently represents a hydrogen atom, an alkyl group having from 1 to 6 carbon atoms, or an alkoxy group having from 1 to 6 carbon atoms.)

[0025]

The epoxy resin which the resin composition of each of the first and second inventions contains is an epoxy resin having a phenolphthalein skeleton. A basic skeleton of the subject epoxy resin is disclosed in British Patent No. 1,158,606 (Patent Document 4). Patent Document 4 discloses results in which an epoxy equivalent per kg is 3.4 (294 g/eq. when converted into a current epoxy equivalent), a hue is Gardner 8 (40% in methyl glycol), a softening point is 66°C (kolfer heater), and a chlorine content is 2.2%. In addition, Patent Document 4 discloses curing physical properties with DDS (diaminodiphenylsulfone).

If things go on like this, it is difficult to spread the subject epoxy resin into optical materials, and a resin with higher transparency is demanded.

the quaternary ammonium salt is generally from 0.1 to 15 g, and preferably from 0.2 to 10 g per mole of the hydroxyl group of the raw material phenol mixture.

[0048]

In the subject reaction, in addition to the above-described epihalohydrin, it is preferable to use a non-polar protic solvent (e.g., dimethyl sulfoxide, dioxane, dimethyl imidazolidinones, etc.) or an alcohol having from 1 to 5 carbon atoms in combination. Examples of the alcohol having from 1 to 5 carbon atoms include alcohols such as methanol, ethanol, isopropyl alcohol, and the like. A use amount of the non-polar protic solvent or alcohol having from 1 to 5 carbon atoms is generally from 2 to 50% by weight, and preferably from 4 to 25% by weight relative to the use amount of the epihalohydrin. In addition, epoxidation may be performed while controlling the moisture in the system by a technique such as azeotropic dehydration, etc.

In the case where a lot of moisture is contained in the system, there is a concern that the electrical reliability is deteriorated in the resulting epoxy resin, and hence, such is not preferable. It is preferable to perform the synthesis by controlling the moisture to not more than 5%. In addition, on the occasion of obtaining the epoxy resin by using a non-polar protic solvent, an epoxy resin with excellent electrical reliability is obtained, and therefore, the non-polar protic solvent can be suitably used.

[0049]

A reaction temperature is generally from 30 to 90°C, and preferably from 35 to 80°C. In particular, in the present invention, in order to perform the epoxidation with a higher purity, the reaction temperature is preferably 60°C or higher, and a reaction under a condition close to a reflux condition is especially preferable. A reaction time is generally from 0.5 to 10 hours, preferably from 1 to 8 hours, and especially preferably from 1 to 3 hours. When the reaction time is too short, the reaction does not proceed completely, whereas when the reaction time is too long, there is a concern that a by-product is formed.

The epihalohydrin or solvent or the like is removed by heating under reduced pressure after (or without) washing a reaction product of such an epoxidation reaction with water. In addition, for the purpose of producing an epoxy resin having a smaller amount of a hydrolyzable halogen, the cyclization can also be made sure by dissolving the recovered epoxy resin in a ketone having from 4 to 7 carbon atoms (examples thereof include methyl isobutyl ketone, methyl ethyl ketone, cyclopentanone,

polymerization initiator WPI-016, available from Wako Pure Chemical Industries, Ltd.), and the like.

[0081]

As the active energy ray at the time when the curable resin composition B of the present invention is cured, though X-rays, electron beams, ultraviolet rays, visible light, and the like can be used, ultraviolet rays or visible light is preferable, and ultraviolet rays are especially preferable. In the case of using ultraviolet rays, though a wavelength range thereof is not particularly limited, it is preferably from 150 to 400 nm, and more preferably from 200 to 380 nm. In the case of using ultraviolet rays, the cationic polymerization can be efficiently initiated.

[0082]

In addition, in the curable resin composition B of the present invention, for the purpose of more increasing the activity of the photocationic polymerization initiator, a sensitizer can also be used in combination as the need arises. As the sensitizer which can be used in the present invention, it is possible to use compounds disclosed in, for example, *Adv. in Polymer Sci.*, 62, 1 (1984) by Crivello. Specifically, examples thereof include pyrene, perylene, acridine orange, thioxanthone, 2-chlorothioxanthone, benzoflavin, and the like. In addition, compounds which are widely used as a photo-radical polymerization initiator can also be used. Specifically, examples thereof include benzophenone; thioxanthones such as 2,4-diethylthioxanthone, 2-isopropylthioxanthone, 2,4-dichlorothioxanthone, etc.; benzoin ethers such as benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, etc.; benzyl dimethyl ketals such as 2,2-dimethoxy-1,2-diphenylethan-1-one, etc.; α-hydroxyalkylphenones such as 2-hydroxy-2-methyl-1-phenylpropan-1-one, 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropan-1-one, 1-hydroxycyclohexyl phenyl ketone, etc.; α-dicarbonyl compounds such as camphor quinone, etc.; and the like. In the present invention, thioxanthones or α-hydroxyalkylphenones can be especially suitably used.

[0083]

A compounding amount of the photocationic polymerization initiator in the curable resin composition B of the present invention can be properly adjusted according to the kind or irradiation dose of the active energy ray. For example, in the case of ultraviolet rays, the compounding amount of the photocationic polymerization initiator is preferably from 0.1 to 10 parts by mass, more preferably from 0.5 to 5 parts, and still

more preferably from 1 to 3 parts based on 100 parts by mass of a total amount of the cationic curable resin composition B. In the case where the compounding amount of the cationic polymerization initiator is less than 0.1 parts, there is a concern that the curing properties are inferior. Conversely, in the case where the compounding amount of the cationic polymerization initiator is more than 10 parts by mass, there may be the case where the components which are truly needed in the cured product are decreased, resulting in a lowering of physical properties of the cured product, or there is a concern that the coloration of the cured product becomes vigorous.

[0084]

In the case of adding the sensitizer to the curable resin composition B of the present invention, its compounding amount can be properly adjusted according to the kind or irradiation dose of the active energy ray. For example, in the case of ultraviolet rays, the compounding amount of the sensitizer is preferably not more than 5 parts by mass, and more preferably from 0.2 to 2 parts based on 100 parts by mass of a total amount of the curable resin composition B. In the case where the compounding amount of the photosensitizer is more than 5 parts by mass, there may be the case where the components which are truly needed in the cured product are decreased, resulting in a lowering of physical properties of the cured product, or there may be the case where the coloration of the cured product becomes vigorous.

[0085]

In the case where the active energy ray is ultraviolet rays or visible light, the cationic curable resin composition is exposed to air. At that time, it is preferable that the humidity of the atmosphere is low, and the humidity is preferably not more than 80% RH, and more preferably not more than 70% RH. Here, in the case of installing ultraviolet rays or visible light in the production line, a method of sending dry air before a light irradiation device or a method of installing a heating device to decrease the humidity can also be adopted.

[0086]

A compound which is activated by heat to initiate the cationic polymerization, namely a thermal cationic polymerization initiator can also be used for the curable resin composition B of the present invention. As such a compound, various onium salts such as quaternary ammonium salts, phosphonium salts, sulfonium salts, etc., combinations of an alkoxysilane with an aluminum complex, and the like can be exemplified.

Examples of available products include ADEKA OPTON CP-66 and ADEKA OPTON CP-77 (all of which are a trade name, available from Adeka Corporation); SAN-AID SI-60L, SAN-AID SI-80L, and SAN-AID SI-100L (all of which are a trade name, available from Sanshin Chemical Industry Co., Ltd.); CI Series (available from Nippon Soda Co., Ltd.); and the like.

[0087]

A compounding proportion of the thermal cationic polymerization initiator in the curable resin composition B of the present invention is in the range of preferably from 0.01 to 10 parts by mass, more preferably from 0.1 to 5 parts, and still more preferably from 0.5 to 3 parts based on 100 parts by mass of the cationic curable resin composition. In the case where this compounding proportion is less than 0.01 parts by mass, there is a concern that even when the activation is performed by the action of heat, a ring-opening reaction of the ring-opening polymerizable group cannot be thoroughly advanced. In addition, even when the thermal cationic polymerization initiator is compounded in a proportion exceeding 10 parts by mass, the action of advancing the polymerization does not increase any more, and there is a concern that physical properties of the cured product are lowered, and hence, such is not preferable.

[0088]

Furthermore, an inorganic filler, a variety of compounding agents such as a silane coupling material, a mold releasing agent, a pigment, etc., or a variety of compounding agents of various thermosetting resins can be added in the curable resin composition B of the present invention as the need arises. Specific examples thereof are as follows.

[0089]

The curable resin composition B of the present invention is obtained by uniformly mixing the respective components. In addition, after uniformly dissolving the curable resin composition B of the present invention in an organic solvent such as polyethylene glycol monoethyl ether, cyclohexanone, γ-butyrolactone, etc., the solvent is removed by heating, thereby making it possible to use the resultant. On that occasion, the solvent is used in a proportion of generally from 10 to 70% by mass, and preferably from 15 to 70% by mass in the mixture of the curable resin composition B of the present invention and the solvent.

of the binder resin are also the same as those in the curable resin composition A of the first invention as described above.

[0114]

Similar to the curable resin composition A of the first invention as described above, the curable resin composition 2A of the present invention can be added with an inorganic filler as the need arises. Specific examples and use amount of the inorganic filler are also the same as those in the curable resin composition A of the first invention as described above.

[0115]

Similar to the case of the curable resin composition A of the first invention as described above, in the case of using the curable resin composition 2A of the present invention for an optical semiconductor encapsulating agent, a fluorescent material can be added as the need arises. Specific examples and use amount of the fluorescent material are also the same as those in the curable resin composition A of the first invention as described above.

[0116]

Similar to the curable resin composition of the first invention as described above, the curable resin composition 2A of the present invention is obtained by unfirmly mixing the respective components and can be easily formed into a cured product thereof by the same method as a conventionally known method.

[0117]

In addition, the curable resin composition A of the present invention can be formed into a cured product in the same technique as that in the curable resin composition A of the first invention as described above.

[0118]

Curable resin composition 2B (cationic curing with an acidic curing catalyst)

Similar to the curable resin composition B of the first invention as described above, the curable resin composition 2B of the present invention to be cured by using an acidic curing catalyst contains a photopolymerization initiator or a thermal polymerization initiator as the acidic curing catalyst. Furthermore, the curable resin composition 2B of the present invention may contain various known compounds or materials, and the like, such as a diluent, a polymerizable monomer, a polymerizable oligomer, a polymerization initiation assistant, a photosensitizer, etc. In addition, if

Table 1

			Example			Comparative Example
			2	3	4	2
Compounding formulation						
	Epoxy resin	EP1	26.6		26.6	
		EP2		27		
		EP3				29.7
		EHPE-3150			7.98	
	Curing agent	H-1	15.39	15.39		15.39
	Curing promoter	PX-4MP	0.08			0.09
		Zinc ethylhexanoate		0.08		
	Cationic polymerization catalyst	SI-150L			0.69	
	Solvent	Methyl ethyl ketone	8.4	8.48	6.92	9.02
Characteristic of cured product		Tint (YI)	0.4	0.7	1.2	38.1

Table 2

			Equivalent of functional group	Example				Comparative Example
				2-1	2-2	2-3	2-4	2-1
Compounding formulation								
	Epoxy resin	EP2-1	266	26.6				26.6
		EP2-2	266		26.6			
		EP2-3	277			27.7		
		EP	270				27	
	Curing agent	HA1	106	10.6		10.6	10.8	
		HA2	154					13.9
	Curing promoter	C1		0.4		0.42		
		C2					0.41	0.53
	Cationic polymerization catalyst	C3			0.80			
	Inorganic filler	Fused silica	Content: 86%	231	231	238	234	252
	Additive	Coupling agent		1.15	1.15	1.19	1.17	1.26
	Mold releasing agent	Carnauba wax		1.04	1.04	1.07	1.05	1.13
Curing physical property		Flame retardancy	In conformity with UL94	V-0	V-0	V-0	V-0	Total loss by fire

HA1	Phenol resin: Phenol aralkyl resin (MILEX XLC-, available from Mitsui Chemicals, Inc.)
HA2	Acid anhydride: Hexahydrophthalic anhydride (RIKACID HH, available from New Japan chemical Co., Ltd.)
C1	Phosphorus-based catalyst: TPP, available from Hokko Chemical Industry Co., Ltd.
C2	Imidazole catalyst: 2E4MZ, available from Shikoku Chemicals Corporation
C3	Onium salt catalyst: SI-150L, available from Sanshin Chemical Industry Co., Ltd.
Inorganic filler	Fused silica: MSR-2212, available from Tatsumori Ltd.
Coupling agent	Silane coupling agent: KBM-403, available from Shin-Etsu Chemical Co., Ltd.
	Carnauba wax: Carnauba wax No. 1, available from Cerarica Noda Co., Ltd.
Curing condition	120°C for 2 hours, 160°C for 2 hours, and 180°C for 4 hours

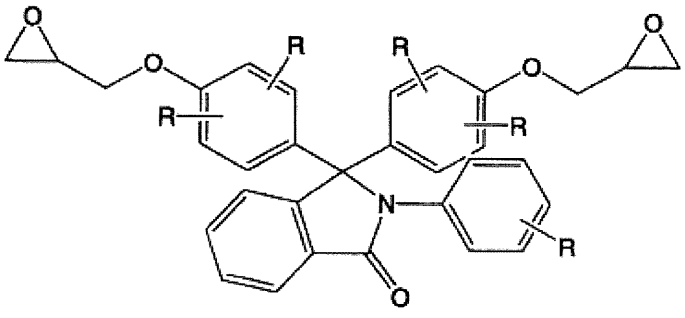
[0021]

(In the formula, each of plurally existent Rs independently represents a hydrogen atom, an alkyl group having from 1 to 6 carbon atoms, or an alkoxy group having from 1 to 6 carbon atoms.)

[0022]

In addition, the second aspect of the present invention (hereinafter also referred to as "second invention") is concerned with a curable resin composition containing an epoxy resin represented by the following formula (2) and a phenol resin and/or a polymerization catalyst.

[0023]



(2)

[0024]

(In the formula, each of plurally existent Rs independently represents a hydrogen atom, an alkyl group having from 1 to 6 carbon atoms, or an alkoxy group having from 1 to 6 carbon atoms.)

[0025]

The epoxy resin which the resin composition of each of the first and second inventions contains is an epoxy resin having a phenolphthalein skeleton. A basic skeleton of the subject epoxy resin is disclosed in British Patent No. 1,158,606 (Patent Document 4). Patent Document 4 discloses results in which an epoxy equivalent per kg is 3.4 (294 g/eq. when converted into a current epoxy equivalent), a hue is Gardner 8 (40% in methyl glycol), a softening point is 66°C (kolfer heater), and a chlorine content is 2.2%. In addition, Patent Document 4 discloses cured products with DDS (diaminodiphenylsulfone).

If things go on like this, it is difficult to spread the subject epoxy resin into optical materials, and a resin with higher transparency is demanded.

the quaternary ammonium salt is generally from 0.1 to 15 g, and preferably from 0.2 to 10 g per mole of the hydroxyl group of the raw material phenol mixture.

[0048]

In the subject reaction, in addition to the above-described epihalohydrin, it is preferable to use an aprotic polar solvent (e.g., dimethyl sulfoxide, dioxane, dimethyl imidazolidinones, etc.) or an alcohol having from 1 to 5 carbon atoms in combination. Examples of the alcohol having from 1 to 5 carbon atoms include alcohols such as methanol, ethanol, isopropyl alcohol, and the like. A use amount of the aprotic polar solvent or alcohol having from 1 to 5 carbon atoms is generally from 2 to 50% by weight, and preferably from 4 to 25% by weight relative to the use amount of the epihalohydrin. In addition, epoxidation may be performed while controlling the moisture in the system by a technique such as azeotropic dehydration, etc.

In the case where a lot of moisture is contained in the system, there is a concern that the electrical reliability is deteriorated in the resulting epoxy resin, and hence, such is not preferable. It is preferable to perform the synthesis by controlling the moisture to not more than 5%. In addition, on the occasion of obtaining the epoxy resin by using an aprotic polar solvent, an epoxy resin with excellent electrical reliability is obtained, and therefore, the aprotic polar solvent can be suitably used.

[0049]

A reaction temperature is generally from 30 to 90°C, and preferably from 35 to 80°C. In particular, in the present invention, in order to perform the epoxidation with a higher purity, the reaction temperature is preferably 60°C or higher, and a reaction under a condition close to a reflux condition is especially preferable. A reaction time is generally from 0.5 to 10 hours, preferably from 1 to 8 hours, and especially preferably from 1 to 3 hours. When the reaction time is too short, the reaction does not proceed completely, whereas when the reaction time is too long, there is a concern that a by-product is formed.

The epihalohydrin or solvent or the like is removed by heating under reduced pressure after (or without) washing a reaction product of such an epoxidation reaction with water. In addition, for the purpose of producing an epoxy resin having a smaller amount of a hydrolyzable halogen, the cyclization can also be made sure by dissolving the recovered epoxy resin in a ketone having from 4 to 7 carbon atoms (examples thereof include methyl isobutyl ketone, methyl ethyl ketone, cyclopentanone,

polymerization initiator WPI-016, available from Wako Pure Chemical Industries, Ltd.), and the like.

[0081]

As the active energy ray at the time when the curable resin composition B of the present invention is cured, though X-rays, electron beams, ultraviolet rays, visible light, and the like can be used, ultraviolet rays or visible light is preferable, and ultraviolet rays are especially preferable. In the case of using ultraviolet rays, though a wavelength range thereof is not particularly limited, it is preferably from 150 to 400 nm, and more preferably from 200 to 380 nm. In the case of using ultraviolet rays, the cationic polymerization can be efficiently initiated.

[0082]

In addition, in the curable resin composition B of the present invention, for the purpose of more increasing the activity of the photocationic polymerization initiator, a sensitizer can also be used in combination as the need arises. As the sensitizer which can be used in the present invention, it is possible to use compounds disclosed in, for example, *Adv. in Polymer Sci.*, 62, 1 (1984) by Crivello. Specifically, examples thereof include pyrene, perylene, acridine orange, thioxanthone, 2-chlorothioxanthone, benzoflavin, and the like. In addition, compounds which are widely used as a photo-radical polymerization initiator can also be used. Specifically, examples thereof include benzophenone; thioxanthones such as 2,4-diethylthioxanthone, 2-isopropylthioxanthone, 2,4-dichlorothioxanthone, etc.; benzoin ethers such as benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, etc.; benzyl dimethyl ketals such as 2,2-dimethoxy-1,2-diphenylethan-1-one, etc.; α-hydroxyalkylphenones such as 2-hydroxy-2-methyl-1-phenylpropan-1-one, 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropan-1-one, 1-hydroxycyclohexyl phenyl ketone, etc.; α-dicarbonyl compounds such as camphor quinone, etc.; and the like. In the present invention, thioxanthones or α-hydroxyalkylphenones can be especially suitably used.

[0083]

A compounding amount of the photocationic polymerization initiator in the curable resin composition B of the present invention can be properly adjusted according to the kind or irradiation dose of the active energy ray. For example, in the case of ultraviolet rays, the compounding amount of the photocationic polymerization initiator is preferably from 0.1 to 10 parts by mass, more preferably from 0.5 to 5 parts by mass,

and still more preferably from 1 to 3 parts by mass based on 100 parts by mass of a total amount of the cationic curable resin composition B. In the case where the compounding amount of the cationic polymerization initiator is less than 0.1 parts by mass, there is a concern that the curing properties are inferior. Conversely, in the case where the compounding amount of the cationic polymerization initiator is more than 10 parts by mass, there may be the case where the components which are truly needed in the cured product are decreased, resulting in a lowering of physical properties of the cured product, or there is a concern that the coloration of the cured product becomes vigorous.

[0084]

In the case of adding the sensitizer to the curable resin composition B of the present invention, its compounding amount can be properly adjusted according to the kind or irradiation dose of the active energy ray. For example, in the case of ultraviolet rays, the compounding amount of the sensitizer is preferably not more than 5 parts by mass, and more preferably from 0.2 to 2 parts by mass based on 100 parts by mass of a total amount of the curable resin composition B. In the case where the compounding amount of the photosensitizer is more than 5 parts by mass, there may be the case where the components which are truly needed in the cured product are decreased, resulting in a lowering of physical properties of the cured product, or there may be the case where the coloration of the cured product becomes vigorous.

[0085]

In the case where the active energy ray is ultraviolet rays or visible light, the cationic curable resin composition is exposed to air. At that time, it is preferable that the humidity of the atmosphere is low, and the humidity is preferably not more than 80% RH, and more preferably not more than 70% RH. Here, in the case of installing ultraviolet rays or visible light in the production line, a method of sending dry air before a light irradiation device or a method of installing a heating device to decrease the humidity can also be adopted.

[0086]

A compound which is activated by heat to initiate the cationic polymerization, namely a thermal cationic polymerization initiator can also be used for the curable resin composition B of the present invention. As such a compound, various onium salts such as quaternary ammonium salts, phosphonium salts, sulfonium salts, etc., combinations of an alkoxysilane with an aluminum complex, and the like can be exemplified.

Examples of available products include ADEKA OPTON CP-66 and ADEKA OPTON CP-77 (all of which are a trade name, available from Adeka Corporation); SAN-AID SI-60L, SAN-AID SI-80L, and SAN-AID SI-100L (all of which are a trade name, available from Sanshin Chemical Industry Co., Ltd.); CI Series (available from Nippon Soda Co., Ltd.); and the like.

[0087]

A compounding proportion of the thermal cationic polymerization initiator in the curable resin composition B of the present invention is in the range of preferably from 0.01 to 10 parts by mass, more preferably from 0.1 to 5 parts by mass, and still more preferably from 0.5 to 3 parts by mass based on 100 parts by mass of the cationic curable resin composition. In the case where this compounding proportion is less than 0.01 parts by mass, there is a concern that even when the activation is performed by the action of heat, a ring-opening reaction of the ring-opening polymerizable group cannot be thoroughly advanced. In addition, even when the thermal cationic polymerization initiator is compounded in a proportion exceeding 10 parts by mass, the action of advancing the polymerization does not increase any more, and there is a concern that physical properties of the cured product are lowered, and hence, such is not preferable.

[0088]

Furthermore, an inorganic filler, a variety of compounding agents such as a silane coupling material, a mold releasing agent, a pigment, etc., or a variety of compounding agents of various thermosetting resins can be added in the curable resin composition B of the present invention as the need arises. Specific examples thereof are as follows.

[0089]

The curable resin composition B of the present invention is obtained by uniformly mixing the respective components. In addition, after uniformly dissolving the curable resin composition B of the present invention in an organic solvent such as polyethylene glycol monoethyl ether, cyclohexanone, γ-butyrolactone, etc., the solvent is removed by heating, thereby making it possible to use the resultant. On that occasion, the solvent is used in a proportion of generally from 10 to 70% by mass, and preferably from 15 to 70% by mass in the mixture of the curable resin composition B of the present invention and the solvent.

of the binder resin are also the same as those in the curable resin composition A of the first invention as described above.

[0114]

Similar to the curable resin composition A of the first invention as described above, the curable resin composition 2A of the present invention can be added with an inorganic filler as the need arises. Specific examples and use amount of the inorganic filler are also the same as those in the curable resin composition A of the first invention as described above.

[0115]

Similar to the case of the curable resin composition A of the first invention as described above, in the case of using the curable resin composition 2A of the present invention for an optical semiconductor encapsulating agent, a fluorescent material can be added as the need arises. Specific examples and use amount of the fluorescent material are also the same as those in the curable resin composition A of the first invention as described above.

[0116]

Similar to the curable resin composition of the first invention as described above, the curable resin composition 2A of the present invention is obtained by unfirmly mixing the respective components and can be easily formed into a cured product thereof by the same method as a conventionally known method.

[0117]

In addition, the curable resin composition 2A of the present invention can be formed into a cured product in the same technique as that in the curable resin composition A of the first invention as described above.

[0118]

Curable resin composition 2B (cationic curing with an acidic curing catalyst)

Similar to the curable resin composition B of the first invention as described above, the curable resin composition 2B of the present invention to be cured by using an acidic curing catalyst contains a photopolymerization initiator or a thermal polymerization initiator as the acidic curing catalyst. Furthermore, the curable resin composition 2B of the present invention may contain various known compounds or materials, and the like, such as a diluent, a polymerizable monomer, a polymerizable oligomer, a polymerization initiation assistant, a photosensitizer, etc. In addition, if

Table 1

		Example			Comparative Example
		2	3	4	2
Compounding formulation					
Epoxy resin	EP1	26.6		26.6	
	EP2		27		
	EP3				29.7
	EHPE-3150			7.98	
Curing agent	H-1	15.39	15.39		15.39
Curing promoter	PX-4MP	0.08			0.09
	Zinc ethylhexanoate		0.08		
Cationic polymerization catalyst	SI-150L			0.69	
Solvent	Methyl ethyl ketone	8.4	8.48	6.92	9.02
Characteristic of cured product	Tint (YI)	0.4	0.7	1.2	38.1

Table 2

		Equivalent of functional group	Example				Comparative Example
			2-1	2-2	2-3	2-4	2-1
Compounding formulation							
Epoxy resin	EP2-1	266	26.6				26.6
	EP2-2	266		26.6			
	EP2-3	277			27.7		
	EP	270				27	
Curing agent	HA1	106	10.6		10.6	10.8	
	HA2	154					13.9
Curing promoter	C1		0.4		0.42		
	C2					0.41	0.53
Cationic polymerization catalyst	C3			0.80			
Inorganic filler	Fused silica	Content: 86%	231	231	238	234	252
Additive	Coupling agent		1.15	1.15	1.19	1.17	1.26
Mold releasing agent	Carnauba wax		1.04	1.04	1.07	1.05	1.13
Characteristic of cured product	Flame retardancy	In conformity with UL94	V-0	V-0	V-0	V-0	Total loss by fire

HA1	Phenol resin: Phenol aralkyl resin (MILEX XLC-3L, available from Mitsui Chemicals, Inc.)
HA2	Acid anhydride: Hexahydrophthalic anhydride (RIKACID HH, available from New Japan chemical Co., Ltd.)
C1	Phosphorus-based catalyst: TPP, available from Hokko Chemical Industry Co., Ltd.
C2	Imidazole catalyst: 2E4MZ, available from Shikoku Chemicals Corporation
C3	Onium salt catalyst: SI-150L, available from Sanshin Chemical Industry Co., Ltd.
Inorganic filler	Fused silica: MSR-2212, available from Tatsumori Ltd.
Coupling agent	Silane coupling agent: KBM-403, available from Shin-Etsu Chemical Co., Ltd.
	Carnauba wax: Carnauba wax No. 1, available from Cerarica Noda Co., Ltd.
Curing condition	120°C for 2 hours, 160°C for 2 hours, and 180°C for 4 hours