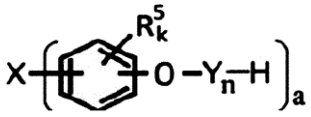
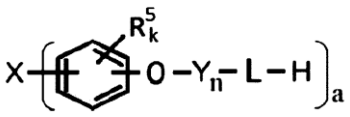
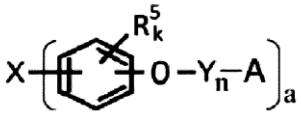
Claims

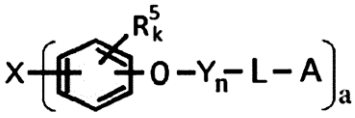
[Claim 1]

A polyphenylene ether having a structure represented by formula (1a), formula (1b), formula (1c), or formula (1d) below:


(1a)

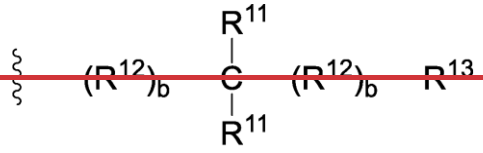

(1c)


(1b)


(1d)

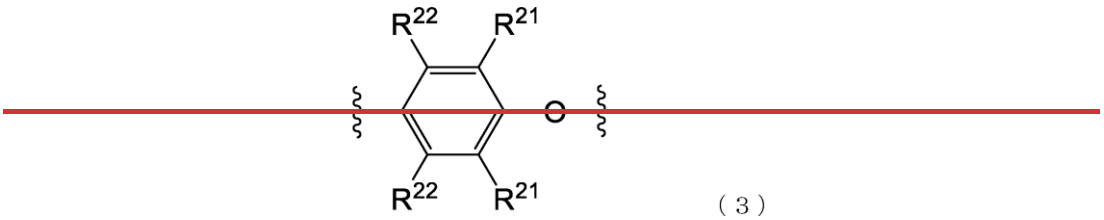
wherein

X is an arbitrary a-valent linking group; a is an integer of 3 to 6; each R^5 is independently an arbitrary substituent, each k is independently an integer of 1 to 4; at least one of a number k of R^5 includes a group represented by formula (2) below; each Y is independently a divalent linking group represented by formula (3) below; each n represents number of repetitions of Y and is independently an integer of 1 to 200; each L is independently an arbitrary divalent linking group; and each A independently represents a substituent containing a carbon-carbon double bond and/or an epoxy bond:


(2)

wherein

~~each R^{11} is independently a C1-8 alkyl group; each R^{12} is independently a C1-8 alkylene group; each b is independently 0 or 1; R^{13} represents any one of a hydrogen atom, a C1-8 alkyl group, and a phenyl group; and the alkyl group, the alkylene group, and the phenyl group may have a substituent within a limit satisfying the requirement of C1-8,~~



(3)

~~wherein~~

~~each R^{21} is independently a saturated or unsaturated C1-6 hydrocarbon group, and~~

~~each R^{22} is independently a hydrogen atom or a saturated or unsaturated C1-6 hydrocarbon group, and the saturated or unsaturated hydrocarbon group may have a substituent within a limit satisfying the requirement of C1-6.~~

~~[Claim 2]~~

~~The polyphenylene ether according to claim 1, wherein~~

~~the group represented by formula (2) is directly bonded to the benzene ring to which R^{5} is bonded.~~

~~[Claim 3]~~

~~The polyphenylene ether according to claim 1 or 2, wherein~~

each of R^{11} and R^{13} in the group represented by formula (2) is a methyl group.

[Claim 4]

The polyphenylene ether according to any one of claims 1 to 3, wherein

the group represented by formula (2) is a t-Bu group.

[Claim 5]

The polyphenylene ether according to any of claims 1 to 4, wherein

the group represented by formula (2) is bonded to 2-position and/or 6-position of the benzene ring to which R^5 is bonded.

[Claim 6]

The polyphenylene ether according to any one of claims 1 to 5, wherein

R^{21} in the group represented by formula (3) is a methyl group.

[Claim 7]

The polyphenylene ether according to any one of claims 1 to 6, wherein

a number-average molecular weight is 500 to 30000 in terms of polystyrene.

[Claim 8]

A polyphenylene ether composition comprising 0.5% to 95% by mass of the polyphenylene ether according to any one of claims 1 to 7.

[Claim 9]

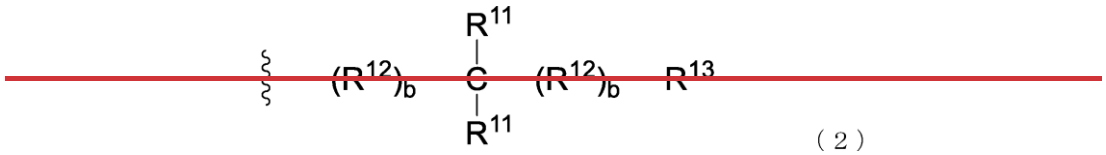
~~The polyphenylene ether composition according to claim 8, for use in a prepreg.~~

~~[Claim 10]~~

~~A manufacturing method of a polyphenylene ether, comprising~~

~~a step of reacting an arbitrary polyphenylene ether with an a-valent phenol having a group represented by formula (2) below, provided that a = 3 to 6; and~~

~~a step of introducing a substituent containing a carbon-carbon double bond and/or an epoxy bond into a terminal of the polyphenylene ether obtained:~~



(2)

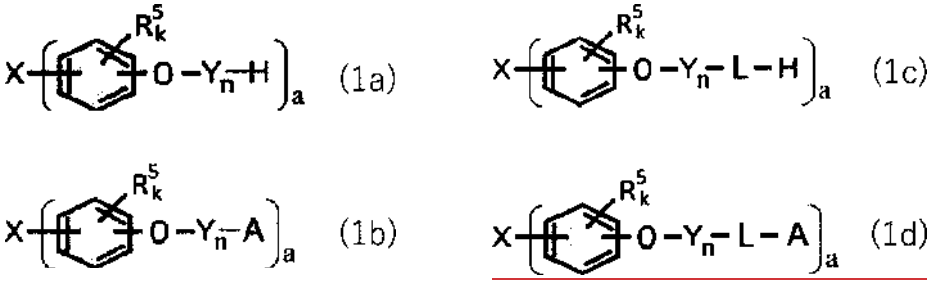
~~wherein~~

~~each R^{11} is independently a C1-8 alkyl group; each R^{12} is independently a C1-8 alkylene group; each b is independently 0 or 1; R^{13} represents any one of a hydrogen atom, a C1-8 alkyl group, and a phenyl group; and the alkyl group, the alkylene group, and the phenyl group may have a substituent within a limit satisfying the requirement of C1-8.~~

Claims

[Claim 1]

A polyphenylene ether having a structure represented by formula (1a), formula (1b), formula (1c), or formula (1d) below:

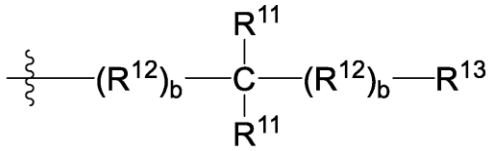


(1a) (1c)

(1b) (1d)

wherein

X is an arbitrary a-valent linking group; a is an integer of 3 to 6; each R^5 is independently an arbitrary substituent, each k is independently an integer of 1 to 4; at least one of a number k of R^5 includes a group represented by formula (2) below; each Y is independently a divalent linking group represented by formula (3) below; each n represents number of repetitions of Y and is independently an integer of 1 to 200; each L is independently an arbitrary divalent linking group; and each A independently represents a substituent containing a carbon-carbon double bond and/or an epoxy bond:



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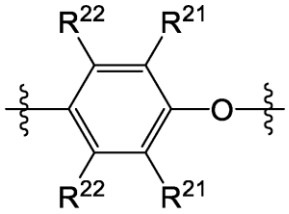
wherein

each R^{11} is independently a C1-8 alkyl group; each R^{12} is independently a C1-8 alkylene group; each b is independently 0 or 1; R^{13} represents any one of a hydrogen atom, a C1-8 alkyl group, and a phenyl group; and the alkyl group, the alkylene group, and the phenyl group may have a substituent within a limit satisfying the requirement of C1-8,



(3)

wherein

each R^{21} is independently a saturated or unsaturated C1-6 hydrocarbon group, and

each R^{22} is independently a hydrogen atom or a saturated or unsaturated C1-6 hydrocarbon group, and the saturated or unsaturated hydrocarbon group may have a substituent within a limit satisfying the requirement of C1-6,

disclaiming that a portion excluding the structure represented by -Y_n-H, -Y_n-A, -Y_n-L-H or -Y_n-L-A from the structures represented by formula (1a), formula (1b), formula (1c) or formula (1d) includes a group removed all hydrogen atoms of terminal phenolic hydroxyl group from pentaerythritol tetrakis(3-(3,5-di-tert-butyl-4-hydroxyphenyl) propionate)

; and

having 500 to 10000 of a number-average molecular weight in terms of polystyrene.

[Claim 2]

The polyphenylene ether according to claim 1, wherein

the group represented by formula (2) is directly bonded to the benzene ring to which R_5 is bonded.

[Claim 3]

The polyphenylene ether according to claim 1 or 2, wherein

each of R^{11} and R^{13} in the group represented by formula (2) is a methyl group.

[Claim 4]

The polyphenylene ether according to any one of claims 1 to 3, wherein

the group represented by formula (2) is a t-Bu group.

[Claim 5]

The polyphenylene ether according to any of claims 1 to 4, wherein

the group represented by formula (2) is bonded to 2-position and/or 6-position of the benzene ring to which R^5 is bonded.

[Claim 6]

The polyphenylene ether according to any one of claims 1 to 5, wherein

R_{21} in the group represented by formula (3) is a methyl group.

[Claim 7]

A polyphenylene ether composition comprising 0.5% to 95% by mass of the polyphenylene ether according to any one of claims 1 to 6.

[Claim 8]

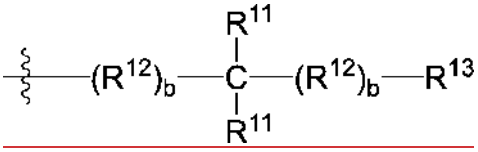
The polyphenylene ether composition according to claim 7, for use in a prepreg.

[Claim 9]

A manufacturing method of a polyphenylene ether, comprising

a step of reacting an arbitrary polyphenylene ether with an a-valent phenol having a group represented by formula (2) below, provided that a = 3 to 6; and

a step of introducing a substituent containing a carbon-carbon double bond and/or an epoxy bond into a terminal of the polyphenylene ether obtained:



wherein

each R^{11} is independently a C1-8 alkyl group; each R^{12} is independently a C1-8 alkylene group; each b is independently 0 or 1; R^{13} represents any one of a hydrogen atom, a C1-8 alkyl group, and a phenyl group; and the alkyl group, the alkylene group, and the phenyl group may have a substituent within a limit satisfying the requirement of C1-8,

disclaiming that the phenol is pentaerythritol tetrakis(3-(3,5-di-tert-butyl-4-hydroxyphenyl) propionate)

; and

the polyphenylene ether has 500 to 10000 of a number-average molecular weight in terms of polystyrene.