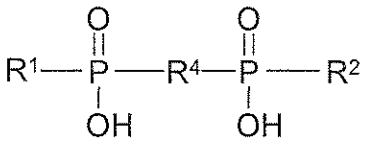
It is an object of the present invention to modify polymers for prepregs, printed circuit boards and laminates such that they are subject only to very low thermal expansion – if any at all – and dimensional stability is fulfilled.

~~This object is achieved by~~In one aspect, there is provided mixtures of at least one diphosphinic acid of the formula (I)



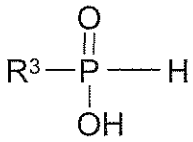
(I)

in which

R^1, R^2 are each H, C_1-C_{18}-alkyl, C_2-C_{18}-alkenyl, C_6-C_{18}-aryl, C_7-C_{18}-alkylaryl

R^4 is C_1-C_{18}-alkylene, C_2-C_{18}-alkenylene, C_6-C_{18}-arylene, C_7-C_{18}-alkylarylene

with at least one alkylphosphinic acid of the formula (II)



(II)

in which

R^3 is C_1-C_{18}-alkyl, C_2-C_{18}-alkenyl, C_6-C_{18}-aryl, C_7-C_{18}-alkylaryl.

Preferably, R^1, R^2 and R^3 are the same or different and are each methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, n-pentyl, isopentyl, n-hexyl, isohexyl and/or phenyl, where R^1 and R^2 may also be H, and R^4 is ethylene, butylene, hexylene or octylene.

More preferably, R^1, R^2 and R^3 are the same or different and are each ethyl or butyl.

allantoin, glycoluril, cyanurates, cyanurate-epoxide compounds, urea cyanurate, dicyanamide, guanidine, guanidine phosphate and/or sulfate.

The mixtures preferably comprise 99 to 1% by weight of the mixture of diphosphinic acids of the formula (I) and alkylphosphinic acid of the formula (II) as claimed in at least one of claims 1 to 12 and 1 to 99% by weight of synergist.

~~The invention also~~Another aspect relates to a process for preparing the mixtures as ~~claimed in at least one of claims 1 to 11~~disclosed herein, wherein a phosphinic acid source is reacted with an alkyne in the presence of an initiator to give a mixture of diphosphinic acids of the formula (I) and alkylphosphinic acid of the *formula (II)*.

Preferably, the phosphinic acid source is ethylphosphinic acid and the alkyne is acetylene, methylacetylene, 1-butyne, 1-hexyne, 2-hexyne, 1-octyne, 4-octyne, 1-butyn-4-ol, 2-butyn-1-ol, 3-butyn-1-ol, 5-hexyn-1-ol, 1-octyn-3-ol, 1-pentyne, phenylacetylene, trimethylsilylacetylene and/or diphenylacetylene.

The initiator is preferably a free-radical initiator having a nitrogen-nitrogen or an oxygen-oxygen bond.

The free-radical initiator is preferably 2,2'-azobis(2-amidinopropane) dihydrochloride, 2,2'-azobis(N,N'-dimethyleneisobutyramidine) dihydrochloride, azobis(isobutyronitrile), 4,4'-azobis(4-cyanopentanoic acid) and/or 2,2'-azobis(2-methylbutyronitrile) or hydrogen peroxide, ammonium peroxodisulfate, potassium peroxodisulfate, dibenzoyl peroxide, di-tert-butyl peroxide, peracetic acid, diisobutyryl peroxide, cumene peroxyneodecanoate, tert-butyl peroxyneodecanoate, tert-butyl peroxypivalate, tert-amyl peroxypivalate, dipropyl peroxydicarbonate, dibutyl peroxydicarbonate, dimyristyl peroxydicarbonate, dilauroyl peroxide, 1,1,3,3-tetramethylbutyl peroxy-2-ethylhexanoate, tert-amyl peroxy-2-ethylhexylcarbonate, tert-butyl peroxyisobutyrate, 1,1-di(tert-butylperoxy)cyclohexane, tert-butyl peroxybenzoate, tert-butyl peroxyacetate, tert-butyl peroxydiethylacetate, tert-butyl peroxyisopropylcarbonate, 2,2-di(tert-

butylperoxy)butane, tert-amyl hydroperoxide and/or 2,5-dimethyl-2,5-di(tert-butylperoxy)hexane.

The solvent preferably comprises straight-chain or branched alkanes, alkyl-substituted aromatic solvents, water-immiscible or only partly water-miscible alcohols or ethers, water and/or acetic acid.

The alcohol is preferably methanol, propanol, i-butanol and/or n-butanol or comprises mixtures of these alcohols with water.

The reaction temperature is preferably between 50 and 150°C.

~~The invention also~~Another aspect relates to the use of mixtures disclosed herein~~as claimed in at least one of claims 1 to 11~~ as an intermediate for further syntheses, as a binder, as a crosslinker or accelerator in the curing of epoxy resins, polyurethanes and unsaturated polyester resins, as polymer stabilizers, as crop protection compositions, as sequestrants, as a mineral oil additive, as an anticorrosive, in washing and cleaning composition applications and in electronics applications.

Particular preference is given to the use of mixtures as claimed in at least one of claims 1 to 13 as a flame retardant, especially as a flame retardant for clearcoats and intumescent coatings, as a flame retardant for wood and other cellulosic products, as a reactive and/or nonreactive flame retardant for polymers, for production of flame-retardant polymer molding compositions, for production of flame-retardant polymer moldings and/or for rendering polyester and pure and blended cellulose fabrics flame-retardant by impregnation, and as a synergist.

~~The invention also~~A further aspect relates to flame-retardant thermoplastic or thermoset polymer molding compositions and polymer moldings, films, filaments and fibers comprising 0.5 to 45% by weight of mixtures as disclosed herein~~claimed in at least one of claims 1 to 13~~, 55 to 99.5% by weight of thermoplastic or thermoset polymer or mixtures

thereof, 0 to 55% by weight of additives and 0 to 55% by weight of filler or reinforcing materials, where the sum of the components is 100% by weight.

~~Finally, the invention also~~Another aspect relates to flame-retardant thermoplastic or thermoset polymer molding compositions and polymer moldings, films, filaments and fibers comprising 1 to 30% by weight of mixtures as disclosed herein~~claimed in at least one of claims 1 to 13~~, 10 to 95% by weight of thermoplastic or thermoset polymer or mixtures thereof, 2 to 30% by weight of additives and 2 to 30% by weight of filler or reinforcing materials, where the sum of the components is 100% by weight.

Preferably, R^1 and R^2 are the same or different and are each H, methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, n-pentyl, isopentyl, n-hexyl, isohexyl and/or phenyl; R^3 is (independently of R^1 and R^2) methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl, n-pentyl, isopentyl, n-hexyl, isohexyl and/or phenyl, and R^4 is ethylene, butylene, hexylene or octylene; this means the C_2, C_4, C_6 or C_8 group which connects the two phosphorus atoms.

Preferred two-component mixtures of at least one diphosphinic acid of the formula (I) and at least one alkylphosphinic acid of the formula (II) are composed of
ethylene-1,2-bis(ethylphosphinic acid) and ethylphosphinic acid,
ethylene-1,2-bis(ethylphosphinic acid) and propylphosphinic acid,
ethylene-1,2-bis(ethylphosphinic acid) and butylphosphinic acid,
ethylene-1,2-bis(ethylphosphinic acid) and pentylphosphinic acid,
ethylene-1,2-bis(ethylphosphinic acid) and hexylphosphinic acid,
ethylene-1,2-bis(propylphosphinic acid) and ethylphosphinic acid,
ethylene-1,2-bis(propylphosphinic acid) and propylphosphinic acid,
ethylene-1,2-bis(propylphosphinic acid) and butylphosphinic acid,
ethylene-1,2-bis(propylphosphinic acid) and pentylphosphinic acid,
ethylene-1,2-bis(propylphosphinic acid) and hexylphosphinic acid,
ethylene-1,2-bis(butylphosphinic acid) and ethylphosphinic acid,
ethylene-1,2-bis(butylphosphinic acid) and propylphosphinic acid,
ethylene-1,2-bis(butylphosphinic acid) and butylphosphinic acid,