



(51) International Patent Classification:

C08K 5/00 (2006.01) C08K 3/28 (2006.01)
C08K 3/013 (2018.01) C08K 3/08 (2006.01)
C08K 3/22 (2006.01) C08L 71/02 (2006.01)
C08K 3/26 (2006.01) C08K 5/521 (2006.01)
C08K 3/04 (2006.01) C08K 5/5419 (2006.01)
C08K 3/38 (2006.01) C08K 3/34 (2006.01)

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(21) International Application Number:

PCT/EP2020/053659

(22) International Filing Date:

12 February 2020 (12.02.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

19156985.4 13 February 2019 (13.02.2019) EP

(71) Applicant: SIKA TECHNOLOGY AG [CH/CH]; Zugerstrasse 50, 6340 Baar (CH).

(72) Inventors: MENNECKE, Klaas; Joseph-Weishaarstrasse 13, 79807 Lottstetten (DE). HOFSTETTER, David; Tösstalstrasse 244a, 8405 Winterthur (CH). CHOFFAT, Fabien; Allmendstrasse 12, 4522 Rüttenen (CH).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: THERMALLY CONDUCTIVE CURABLE COMPOSITION

(57) Abstract: The invention relates to a moisture-curable composition, comprising between 0.6 and 15.0 wt.-% of at least one organic polymer containing reactive silane groups, between 70 and 95 wt.-% of at least one filler, at least one dispersion additive, optionally at least one catalyst for the curing of silane-functional polymers and up to 10 wt.-% of at least one plasticizer, characterized in that said filler is selected from the list consisting of aluminium oxide, aluminium hydroxide, boron nitride, aluminium nitride, zinc oxide, silver, copper, aluminium, chalk, aluminosilicate, graphite, and any mixture of these fillers; with the proviso that the amount of chalk in the filler does not exceed 25 wt.-% of the total amount of filler. The moisture-curable composition shows excellent thermal conductivity and is particularly suitable as adhesive, gap filler, or sealant suitable for e-coat applications and battery bonding especially in electric automobile assembly.



THERMALLY CONDUCTIVE CURABLE COMPOSITION

Technical field

The invention relates to curable compositions based on silane-functional
5 polymers and their use as adhesives, sealants, or coatings.

State of the art

Curable compositions based on polymers containing reactive silane groups
play an important role in many industrial applications, for example as
10 adhesives, sealants or coatings. Polymers containing reactive silane groups
are in particular polydiorganosiloxanes, which are commonly referred to as
“silicones” or “silicone rubbers”, and organic polymers containing reactive
silane groups, which are also referred to as “silane-functional polymers”,
“silane-modified polymers” (SMP) or “silane-terminated polymers” (STP).
15 Compositions containing either of these polymers harden via crosslinking
reactions of the reactive silane groups on the polymers, which hydrolyze under
the influence of moisture, condense with one another as silanol groups and
thus form a covalently bonded network and, macroscopically, a cured material.
Both types of these polymers have distinct properties and advantages. For
20 example, silicones possess excellent thermal stability while silane-functional
organic polymers commonly have advantages regarding adhesive properties
and compatibility with substrate materials.

With the increasing use of batteries and electronic equipment nowadays, the
demand for suitable adhesives and sealants in contact with these electronic
25 elements or devices has risen significantly. Especially in electric automobile
assembly, large batteries and a multitude of electronic parts require large
amounts of such sealants and adhesives that cover, seal, or bond electronics
and batteries directly. A particular requirement for these adhesive and sealant
materials is a high heat conductivity, since batteries and electronics generate
30 significant amounts of heat while operating that must be dissipated efficiently to
prevent detrimental heat accumulation on the batteries and electronic parts.
This aspect has proven to be a severe problem for traditionally used curable
compositions, e.g. based on silane-functional polymers. Commonly known

such compositions possess a poor heat conductivity and rather act as thermal insulators than efficient heat conductors. There have been several attempts to formulate curable compositions with high heat conductivity. The current state of the art most commonly uses silicone-based compositions with special fillers.

5 These marketed compositions are curable and show adequate thermal conductivity. However, silicone-based compositions are notoriously difficult to paint or coat and this is a critical problem in the rather young electric automobile industry. Silicones are especially problematic for electrodeposition coating ("e-coat" or cathode-dipping) processes, which are a common and
10 often indispensable process step in automotive manufacturing. Many automotive manufacturers strictly try to avoid silicones in their plants to prevent interference with their e-coat processes.

So far, commercially available thermally conductive compositions are mainly limited to silicones and thus have limited applicability in automotive, especially
15 electric vehicle, manufacturing. Other proposed curable compositions, based on organic silane-functional polymers, do not interfere with the e-coat process, but so far did not prove to be suitable because of their limited thermal conductivity.

There is thus an increasing demand for a curable composition that is suitable
20 for battery and electronics assembly and that possesses high thermal conductivity but at the same time does not interfere with coating or painting processes, in particular e-coat processes.

Summary of the invention

25

It is therefore an object of the present invention to provide a curable composition based on organic polymers containing reactive silane groups that exhibit high thermal conductivity, in particular of at least 2 W/mK according to ASTM D5470, and is suitable as gap-filler, sealant, or adhesive for batteries
30 and electronic equipment.

The present invention achieves these objects with the features of independent claim 1.

The combination of between 0.6 and 15.0 wt.-%, based on the total composition, of at least one organic polymer containing reactive silane groups with between 70 and 95 wt.-%, based on the total composition, of at least one filler, the filler selected from the list consisting of aluminium oxide, aluminium hydroxide, boron nitride, aluminium nitride, zinc oxide, silver, copper, aluminium, chalk, aluminosilicate, graphite, and any mixture of these fillers, and a suitable dispersion additive, surprisingly enables the formulation of a curable material with high thermal conductivity that can be used together with e-coat processes and does not have the disadvantages of silicone-based products.

Further aspects of the invention are the subject of further independent claims. Particularly preferred embodiments of the invention are the subject of the dependent claims.

15

Ways of executing the invention

The present invention relates in a first aspect to a moisture-curable composition, comprising

- between 0.6 and 15.0 wt.-%, based on the total composition, of at least one organic polymer **P** containing reactive silane groups;
- between 70 and 95 wt.-%, based on the total composition, of at least one filler **F**;
- at least one dispersion additive **D**;
- optionally at least one catalyst for the curing of silane-functional polymers;
- up to 10 wt.-%, based on the total composition, of at least one plasticizer **PL**;

25

characterized in that said filler **F** is selected from the list consisting of aluminium oxide, aluminium hydroxide, boron nitride, aluminium nitride, zinc oxide, silver, copper, aluminium, chalk, aluminosilicate, graphite, and any mixture of these fillers; with the proviso that the amount of chalk in the filler **F** does not exceed 25 wt.-% of the total amount of filler **F**.

30

In the present document, the term “reactive silane group” refers to a silyl group that is bonded to an organic radical and has one to three, especially two or three, hydrolyzable substituents or hydroxyl groups on the silicon atom.

- 5 Particularly useful hydrolyzable substituents are alkoxy groups. These silane groups are also referred to as “alkoxysilane groups”. Reactive silane groups may also be in partly or fully hydrolyzed form, for example as silanols.

“Hydroxysilane”, “isocyanatosilane”, “aminosilane” and “mercaptosilane” refer respectively to organoalkoxysilanes having one or more hydroxyl, isocyanato,
10 amino or mercapto groups on the organic radical in addition to the silane group.

“Organofunctional compound” refers to a compound that contains a functional group that is bound via a carbon atom. For example, “aminofunctional compound” is a compound having an aminoalkyl group.

- 15 “Primary amino group” refers to an NH_2 group that is bonded to an organic radical, and “secondary amino group” refers to an NH group that is bonded to two organic radicals which may also together be part of a ring, and “tertiary amino group” refers to an N group that is bonded to three organic radicals, two or three of which together may also be part of one or more rings. Accordingly,
20 “primary aminosilanes” are aminosilanes comprising a primary amino group and “secondary aminosilanes” are aminosilanes comprising a secondary amino group. The latter also encompasses compounds having both a primary and a secondary amino group.

“Polyoxyalkylene radical” refers to a linear or branched hydrocarbonyl radical
25 which contains ether groups and contains more than two repeat units of the (O-R) type in succession, where R is a linear or branched alkylene radical, as for example from the polyaddition of ethylene oxide or 1,2-propylene oxide onto starter molecules having two active hydrogen atoms.

Substance names beginning with “poly”, such as polyol or polyisocyanate, refer
30 to substances containing, in a formal sense, two or more of the functional groups that occur in their name per molecule.

The term “organic polymer” encompasses a collective of macromolecules that are chemically homogeneous but differ in relation to degree of polymerization,

molar mass and chain length, which has been prepared by a poly reaction (polymerization, polyaddition, polycondensation) and has a majority of carbon atoms in the polymer backbone, and reaction products of such a collective of macromolecules. Polymers having a polyorganosiloxane backbone (commonly referred to as “silicones”) are not organic polymers in the context of the present document.

The term “polyether containing reactive silane groups” also encompasses organic polymers which contain silane groups and which, in addition to polyether units, may also contain urethane groups, urea groups or thiourethane groups. Such polyethers containing reactive silane groups may also be referred to as “polyurethanes containing reactive silane groups”.

“Molecular weight” is understood in the present document to mean the molar mass (in grams per mole) of a molecule or part of a molecule, also referred to as “radical”. The term “radical” is used in this document in a formal sense, meaning a molecular rest bound to an atom by a covalent bond, while the bond is formally “cut” to describe the molecular rest attached to it. Molecular weight of polymers is understood as the average molecular weight of their chain length distribution. “Average molecular weight” is understood herein to mean the number-average M_n of an oligomeric or polymeric mixture of molecules or radicals, which is typically determined by means of gel permeation chromatography (GPC) against polystyrene as standard.

“Weight percent” or “percentage by weight”, and its abbreviation “wt.-%” refer to the weight percentage of a certain compound in a total composition, if not otherwise defined. The terms “weight” and “mass” are used interchangeably in this document and refer to the mass as a property of a physical body and commonly measured in kilograms (kg).

“Storage-stable” or “storable” refers to a substance or composition when it can be stored at room temperature in a suitable container over a prolonged period, typically at least 3 months up to 6 months or more, without any change in its application or use properties, especially in the viscosity and crosslinking rate, to a degree of relevance for the use thereof as a result of the storage.

“Room temperature” refers to a temperature of 23°C.

Thermal conductivity λ is defined as ability of material to transmit heat and it is measured in watts per square metre (W/m^2) of surface area for a temperature gradient of 1 K per unit thickness of 1 m. Thermal conductivity of materials disclosed in this document are measured according to ASTM D5470-06.

- 5 All industrial standards and norms cited in this document refer to the respective edition in force on the time of filing of the first application of this invention, if not otherwise defined.

A dotted line in the formulae in this document in each case represents the bond between a substituent and the corresponding molecular radical.

- 10 The term “does not contain polydiorganosiloxanes” means that no such compounds have been added during formulation of the composition. If traces of such species are unknowingly and/or unavoidably present, for example stemming from the synthesis of the silane-functional polymer or due to condensation reactions of silane-functional diorganosilane compounds possibly
15 present in the composition, these are not considered as polydiorganosiloxanes in the meaning of this term. In simpler words, the term “does not contain polydiorganosiloxanes” means that no silicone oils or reactive silicone polymers, in particular polydimethylsiloxanes, were added during formulation of the composition.

20

The composition according to the present invention comprises between 0.6 and 15.0 wt.-%, based on the total composition, of at least one organic polymer **P** containing reactive silane groups.

- 25 In preferred embodiments, the composition comprises less than 12.5 wt.-%, preferably less than 10 wt.-%, more preferably less than 7.5 wt.-%, more preferably less than 6 wt.-%, in particular less than 5 wt.-%, based on the total composition, of said polymer **P** containing reactive silane groups. A higher amount of polymer **P** generally leads to a cured product with better mechanical
30 performance, such as resilience or elasticity. However, for certain applications, a ductile, pasty product is sufficient, if not even advantageous, since it can be removed more easily when the object bonded with the cured composition

needs to be disassembled. Furthermore, the higher the amount of polymer **P**, the lower the thermal conductivity generally will be.

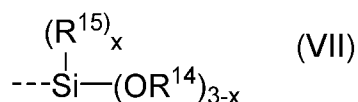
In the same or other preferred embodiments, the composition comprises at least 0.7 wt.-%, preferably at least 1.0 wt.-%, more preferably at least 1.5 wt.-%, in particular at least 1.7 wt.-%, based on the total composition, of said polymer **P** containing reactive silane groups. If the amount of polymer **P** is too low, the composition does not cure properly into a useful pasty product. Below 0.6 wt.-% of polymer **P**, the composition cannot be cured anymore. Therefore it is crucial to include at least 0.6 wt.-% of polymer **P**.

The organic polymer **P** containing reactive silane groups is in particular a polyurethane, polyolefin, polyester, polycarbonate, polyamide, poly(meth)acrylate or polyether or a mixed form of these polymers, each of which bears one or preferably more than one reactive silane group. The silane groups may be in pendant positions in the chain or in terminal positions and are bonded to the organic polymer via a carbon atom.

More preferably, the organic polymer **P** containing reactive silane groups is a polyolefin containing reactive silane groups or a polyurethane containing reactive silane groups or a polyether containing reactive silane groups or a mixed form of these polymers.

Most preferably, the organic polymer containing reactive silane groups is a polyether containing reactive silane groups.

The silane groups present in the organic polymer containing reactive silane groups are preferably alkoxysilane groups, especially alkoxysilane groups of the formula (VII)



where

R^{14} is a linear or branched, monovalent hydrocarbyl radical having 1 to 5 carbon atoms, especially methyl or ethyl or isopropyl;

R¹⁵ is a linear or branched, monovalent hydrocarbyl radical having 1 to 8 carbon atoms, especially methyl or ethyl; and

x is a value of 0 or 1 or 2, preferably 0 or 1, especially 0.

More preferably R¹⁴ is methyl or ethyl.

- 5 For particular applications, the R¹⁴ radical is preferably an ethyl group, since, in this case, ecologically and toxicologically harmless ethanol is released in the course of curing of the composition.

Particular preference is given to trimethoxysilane groups, dimethoxymethylsilane groups or triethoxysilane groups.

- 10 In this context, methoxysilane groups have the advantage that they are particularly reactive, and ethoxysilane groups have the advantage that they are toxicologically advantageous and particularly storage-stable.

- The organic polymer containing reactive silane groups has an average of
15 preferably 1.3 to 4, especially 1.5 to 3, more preferably 1.7 to 2.8, silane groups per molecule. The silane groups are preferably terminal.

- The organic polymer containing reactive silane groups preferably has a average molecular weight, determined by means of GPC against a polystyrene standard, in the range from 1'000 to 30'000 g/mol, especially from 2'000 to
20 20'000 g/mol. The organic polymer containing reactive silane groups preferably has a silane equivalent weight of 300 to 25'000 g/eq, especially of 500 to 15'000 g/eq.

- The organic polymer containing reactive silane groups may be solid or liquid at
25 room temperature. It is preferably liquid at room temperature.

- Most preferably, the organic polymer containing reactive silane groups is a polymer containing reactive silane groups that is liquid at room temperature, where the silane groups are especially dialkoxysilane groups and/or
30 trialkoxysilane groups, more preferably trimethoxysilane groups, methyltrimethoxysilane groups, or triethoxysilane groups.

Processes for preparing organic polymers containing reactive silane groups are known to the person skilled in the art.

In a preferred process, organic polymers containing reactive silane groups are obtainable from the reaction of organic polymers containing allyl groups with
5 hydrosilanes, optionally with chain extension using, for example, diisocyanates.

In a further preferred process, polyethers containing reactive silane groups are obtainable from the copolymerization of alkylene oxides and epoxysilanes, optionally with chain extension using, for example, diisocyanates.

10 In a further preferred process, organic polymers containing reactive silane groups are obtainable from the reaction of organic polyols with isocyanatosilanes, optionally with chain extension using diisocyanates.

In a further preferred process, polyethers containing reactive silane groups are obtainable from the reaction of organic polymers containing isocyanate groups, especially NCO-terminated urethane polymers from the reaction of polyols with
15 a superstoichiometric amount of polyisocyanates, with aminosilanes, hydroxysilanes or mercaptosilanes. This process enables the use of a multitude of inexpensive starting materials of good commercial availability, by means of which it is possible to obtain different polymer properties, for example high extensibility, high strength, low modulus of elasticity, low glass transition
20 point or high weathering resistance.

In some preferred embodiments, the organic polymer **P** containing reactive silane groups is obtainable from the reaction of NCO-terminated urethane polyethers with aminosilanes or hydroxysilanes. Suitable NCO-terminated
25 urethane polymers are obtainable from the reaction of polyols, especially polyether polyols, in particular polyoxyalkylenediols or polyoxyalkylenetriols, preferably polyoxypropylenediols or polyoxypropylenetriols, with a superstoichiometric amount of polyisocyanates, especially diisocyanates. Also other polyols, such as poly(meth)acrylate polyols, polyhydrocarbon polyols, in
30 particular polybutadiene polyols, polyhydroxy functional fats or oils, polycarbonate polyols, polyester polyols and polyhydroxy functional acrylonitrile/butadiene copolymers are suitable. Furthermore, small amounts of

low molecular weight dihydric or polyhydric alcohols, such as diols, glycols, and sugar alcohols may be used as additives.

Preferably, the reaction between the polyisocyanate and the polyol is conducted with exclusion of moisture at a temperature of 50°C to 160°C,

5 optionally in the presence of suitable catalysts, with metered addition of the polyisocyanate in such a way that the isocyanate groups thereof are present in a stoichiometric excess in relation to the hydroxyl groups of the polyol. More particularly, the excess of polyisocyanate is chosen such that a content of free isocyanate groups of 0.1% to 5% by weight, preferably 0.2% to 4% by weight,
10 more preferably 0.3% to 3% by weight, based on the overall polymer, remains in the resulting urethane polymer after the reaction of all hydroxyl groups.

Preferred diisocyanates are selected from the group consisting of

hexamethylene 1,6-diisocyanate (HDI), 1-isocyanato-3,3,5-trimethyl-5-isocyanatomethylcyclohexane (= isophorone diisocyanate or IPDI), tolylene

15 2,4- and 2,6-diisocyanate and any desired mixtures of these isomers (TDI) and diphenylmethane 4,4'-, 2,4'- and 2,2'-diisocyanate and any desired mixtures of these isomers (MDI). Particular preference is given to IPDI or TDI. Most preferred is IPDI. In this way, polyethers containing reactive silane groups with particularly good lightfastness are obtained.

20

Especially suitable as polyether polyols are polyoxyalkylenediols or polyoxyalkylenetriols having a degree of unsaturation lower than 0.02 meq/g, especially lower than 0.01 meq/g, and a mean molecular weight in the range from 400 to 25'000 g/mol, especially 1000 to 20'000 g/mol.

25 As well as polyether polyols, it is also possible to use portions of other polyols, especially polyacrylate polyols, and low molecular weight diols or triols.

Suitable aminosilanes for the reaction with an NCO-terminated urethane polyether are primary and secondary aminosilanes. Preference is given to 3-

30 aminopropyltrimethoxysilane, 3-aminopropyldimethoxymethylsilane, 4-aminobutyltrimethoxysilane, 4-amino-3-methylbutyltrimethoxysilane, 4-amino-3,3-dimethylbutyltrimethoxysilane, N-butyl-3-aminopropyltrimethoxysilane, N-phenyl-3-aminopropyltrimethoxysilane, adducts formed from primary amino-

silanes such as 3-aminopropyltrimethoxysilane, 3-aminopropyldimethoxymethylsilane or N-(2-aminoethyl)-3-aminopropyltrimethoxysilane and Michael acceptors such as acrylonitrile, (meth)acrylic esters, (meth)acrylamides, maleic or fumaric diesters, citraconic diesters or itaconic diesters, especially dimethyl
5 or diethyl N-(3-trimethoxysilylpropyl)aminosuccinate. Likewise suitable are analogs of the aminosilanes mentioned with ethoxy or isopropoxy groups in place of the methoxy groups bonded to the silicon atom.

Suitable hydroxysilanes for the reaction with an NCO-terminated urethane
10 polyether are especially obtainable from the addition of aminosilanes onto lactones or onto cyclic carbonates or onto lactides.

Aminosilanes suitable for the purpose are especially 3-aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, 4-aminobutyltrimethoxysilane, 4-aminobutyltriethoxysilane, 4-amino-3-methylbutyltrimethoxysilane, 4-amino-3-
15 methylbutyltriethoxysilane, 4-amino-3,3-dimethylbutyltrimethoxysilane, 4-amino-3,3-dimethylbutyltriethoxysilane, 2-aminoethyltrimethoxysilane or 2-aminoethyltriethoxysilane. Particular preference is given to 3-aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, 4-amino-3,3-dimethylbutyltrimethoxysilane or 4-amino-3,3-dimethylbutyltriethoxysilane.

20 Suitable lactones are especially γ -valerolactone, γ -octalactone, δ -decalactone, and ϵ -decalactone, especially γ -valerolactone.

Suitable cyclic carbonates are especially 4,5-dimethyl-1,3-dioxolan-2-one, 4,4-dimethyl-1,3-dioxolan-2-one, 4-ethyl-1,3-dioxolan-2-one, 4-methyl-1,3-dioxolan-2-one or 4-(phenoxymethyl)-1,3-dioxolan-2-one.

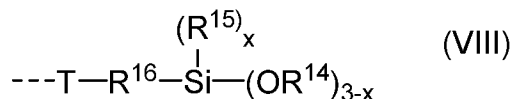
25 Suitable lactides are especially 1,4-dioxane-2,5-dione (lactide formed from 2-hydroxyacetic acid, also called "glycolide"), 3,6-dimethyl-1,4-dioxane-2,5-dione (lactide formed from lactic acid, also called "lactide") and 3,6-diphenyl-1,4-dioxane-2,5-dione (lactide formed from mandelic acid).

Preferred hydroxysilanes which are obtained in this way are N-(3-
30 triethoxysilylpropyl)-2-hydroxypropanamide, N-(3-trimethoxysilylpropyl)-2-hydroxypropanamide, N-(3-triethoxysilylpropyl)-4-hydroxypentanamide, N-(3-triethoxysilylpropyl)-4-hydroxyoctanamide, N-(3-triethoxysilylpropyl)-5-hydroxydecanamide and N-(3-triethoxysilylpropyl)-2-hydroxypropyl carbamate.

In addition, suitable hydroxysilanes are also obtainable from the addition of aminosilanes onto epoxides or from the addition of amines onto epoxysilanes. Preferred hydroxysilanes which are obtained in this way are 2-morpholino-4(5)-
 5 (2-trimethoxysilylethyl)cyclohexan-1-ol, 2-morpholino-4(5)-(2-triethoxysilyl-ethyl)cyclohexan-1-ol or 1-morpholino-3-(3-(triethoxysilyl)propoxy)propan-2-ol.

Further suitable polyethers containing reactive silane groups are commercially available products, especially the following: MS Polymer™ (from Kaneka
 10 Corp.; especially the S203H, S303H, S227, S810, MA903 and S943 products); MS Polymer™ or Silyl™ (from Kaneka Corp.; especially the SAT010, SAT030, SAT200, SAX350, SAX400, SAX725, MAX450, MAX951 products); Excestar® (from Asahi Glass Co. Ltd.; especially the S2410, S2420, S3430, S3630 products); SPUR+* (from Momentive Performance Materials; especially the
 15 1010LM, 1015LM, 1050MM products); Vorasil™ (from Dow Chemical Co.; especially the 602 and 604 products); Desmoseal® (from Bayer MaterialScience AG; especially the S XP 2458, S XP 2636, S XP 2749, S XP 2774 and S XP 2821 products), TEGOPAC® (from Evonik Industries AG; especially the Seal 100, Bond 150, Bond 250 products), Polymer ST (from
 20 Hanse Chemie AG/Evonik Industries AG, especially the 47, 48, 61, 61LV, 77, 80, 81 products); Geniosil® (from Wacker Chemie AG; especially the STP-E10, STP-E15, STP-E30, STP-E35, WP1, and WP2 products).

Particularly preferred organic polymers containing reactive silane groups have
 25 end groups of the formula (VIII)



where

R¹⁶ is a linear or branched divalent hydrocarbyl radical which has 1 to 12 carbon atoms and optionally has cyclic and/or aromatic moieties and optionally one or more heteroatoms, especially one or more nitrogen atoms;

30 T is a divalent radical selected from ---O--- , ---S--- , $\text{---N(R}^{17})\text{---}$, $\text{---O---CO---N(R}^{17})\text{---}$, $\text{---N(R}^{17})\text{---CO---O---}$ and $\text{---N(R}^{17})\text{---CO---N(R}^{17})\text{---}$,

where R^{17} is a hydrogen radical or a linear or branched hydrocarbyl radical which has 1 to 20 carbon atoms and optionally has cyclic moieties, and which optionally has an alkoxysilane, ether or carboxylic ester group; and

5 R^{14} , R^{15} and x have the definitions already given.

Preferably, R^{16} is methylene, 1,3-propylene or 1,4-butylene, where butylene may be substituted by one or two methyl groups.

In an especially preferred embodiment, R^{16} is a methylene radical;

10 Preferably, T is a divalent radical selected from $-O-$, $-S-$, $-N(R^{17})-$, $-O-CO-N(R^{17})-$, $-N(R^{17})-CO-O-$ and $-N(R^{17})-CO-N(R^{17})-$, where R^{17} is a hydrogen radical or a linear or branched hydrocarbyl radical which has 1 to 20 carbon atoms and optionally has cyclic moieties; R^{14} is in particular a methyl or ethyl radical;

15 R^{15} is preferably a methyl radical; and x is preferably 0 or 1.

The composition according to the present invention comprises up to 10 wt.-%, based on the total composition, of at least one plasticizer **PL**. The composition

20 may be formulated without plasticizer, but it is preferred that small amounts of plasticizer are used for ease of compounding and resulting application and mechanical properties. Preferably, the composition comprises between 1 and 9 wt.-%, based on the total composition, of plasticizer **PL**, preferably between 2 and 8 wt.-%, more preferably between 3 and 6 wt.-%.

25

The plasticizer may be any of the plasticizers commonly used in compositions based on silane-functional polymers. These include, for example, carboxylic esters such as phthalates, especially dioctyl phthalate, bis(2-ethylhexyl) phthalate, bis(3-propylheptyl) phthalate, diisononyl phthalate or diisodecyl

30 phthalate, diesters of ortho-cyclohexane-dicarboxylic acid, especially diisononyl 1,2-cyclohexanedicarboxylate, adipates, especially dioctyl adipate, bis(2-ethylhexyl) adipate, azelates, especially bis(2-ethylhexyl) azelate, sebacates, especially bis(2-ethylhexyl) sebacate or diisononyl sebacate, glycol ethers,

glycol esters, organic phosphoric or sulfonic esters, sulfonamides, polybutenes, or fatty acid methyl or ethyl esters derived from natural fats or oils, also called "biodiesel".

- 5 Furthermore suitable are polymeric plasticizers. These have the advantage of lower migration tendency into surrounding areas and lower contribution to VOC levels.

The term "polymeric plasticizer" herein means a polymeric additive that is liquid at room temperature and contains no hydrolyzable silane groups. In contrast to
10 traditional plasticizers, such as phthalates, the polymeric plasticizers generally have a higher molecular weight.

Preferably, the polymeric plasticizer has an average molecular weight M_n of 500 to 12'000 g/mol, in particular 1'000 to 10'000 g/mol, more preferably 2'500 to 5'000 g/mol.

15

Suitable polymeric plasticizers include polyols, such as those suitable for the production of the organic polymers **P** mentioned there, as long as they are liquid at room temperature, and polyols where the OH-groups have been reacted to chemically inert functional groups. Preferred polyols suitable as
20 polymeric plasticizers include polyether polyols, polyester polyols, polyhydrocarbon polyols, polybutadiene polyols, and poly(meth)acrylate polyols. Particularly preferred are polyether polyols, especially those with an average molecular weight of M_n of 500 to 12'000 g/mol, especially 1'000 to 10'000 g/mol, more preferably 2'500 to 5'000 g/mol.

25

Most preferred plasticizers **PL** for the moisture-curable composition according to the present invention comprise or consist of a trialkyl and/or triaryl phosphate, for example triethyl phosphate, tricresyl phosphate, triphenyl phosphate, diphenyl cresyl phosphate, isodecyl diphenyl phosphate, tris(1,3-dichloro-2-propyl) phosphate, tris(2-chloroethyl) phosphate, tris(2-ethylhexyl)
30 phosphate, tris(chloroisopropyl) phosphate, tris(chloropropyl) phosphate, isopropylated triphenyl phosphate, mono-, bis- or tris(isopropylphenyl) phosphates. Preferred trialkyl and/or triaryl phosphate plasticizers **PL** are tris-

(2-ethylhexyl)-phosphate (sold under the trade name Disflamoll® TOF by Lanxess), cresyl diphenyl phosphate, tricresyl phosphate, and triphenyl phosphate (all sold under the trade name range Disflamoll® by Lanxess). Trialkyl and/or triaryl phosphate plasticizers have the advantage that they
5 improve the flame-retardant properties of the composition. Most preferred plasticizer is tris-(2-ethylhexyl)-phosphate.

The composition furthermore optionally comprises at least one catalyst for the curing of silane-functional polymers. The addition of catalyst is advantageous
10 to ensure a sufficient curing rate given the fact that low amounts of reactive polymers are used. However, a catalyst is not in every case necessary. In particular when using a highly reactive polymer **P**, for example one with a methylene group between the reactive silane group and the organic linker group (R^{16} = methylene in Formula (VIII)), a catalyst may be omitted.
15 Suitable catalysts are especially metal compounds and/or basic nitrogen or phosphorus compounds.

Suitable metal compounds are especially compounds of tin, titanium, zirconium, aluminum or zinc, especially diorganotin(IV) compounds such as, in
20 particular, dibutyltin(IV) diacetate, dibutyltin(IV) dilaurate, dibutyltin(IV) dineodecanoate or dibutyltin(IV) bis(acetylacetonate) and dioctyltin(IV) dilaurate, and also titanium(IV) or zirconium(IV) or aluminum(III) or zinc(II) complexes, especially with alkoxy, carboxylate, 1,3-diketonate, 1,3-ketoesterate or 1,3-ketoamidate ligands.

25

Suitable basic nitrogen or phosphorus compounds are especially imidazoles, pyridines, phosphazene bases, secondary or tertiary amines, hexahydrotriazines, biguanides, guanidines, or amidines.

30 Nitrogen-containing compounds suitable as catalysts are in particular amines, especially N-ethyl-diisopropylamine, N,N,N',N'-tetramethylalkylenediamines, 1,4-diazabicyclo[2.2.2]octane; amidines such as especially 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU), 1,5-diazabicyclo[4.3.0]non-5-ene

(DBN), 6-dibutylamino-1,8-diazabicyclo-[5.4.0]undec-7-ene; guanidines such as especially tetramethylguanidine, 2-guanidino-benzimidazole, acetylacetone-guanidine, 3-di-o-tolyl-guanidine, 2-tert-butyl-1,1,3,3-tetramethyl guanidine; and imidazoles, in particular N-(3-trimethoxysilylpropyl)-4,5-dihydroimidazole and
5 N-(3-triethoxysilylpropyl)-4,5-dihydroimidazole.

The composition according to the present invention comprises between 70 and 95 wt.-%, based on the total composition, of at least one filler **F**.

Said filler **F** is selected from the list consisting of aluminium oxide, aluminium
10 hydroxide, boron nitride, aluminium nitride, zinc oxide, silver, copper, aluminium, chalk, especially natural, ground or precipitated calcium carbonates, optionally coated with fatty acids, especially stearic acid, aluminosilicate, graphite, and any mixture of these fillers, with the proviso that the amount of chalk in the filler **F**, if present at all, does not exceed 25 wt.-% of
15 the total amount of filler **F**.

Preferred fillers **F** are selected from the list consisting of aluminium oxide, aluminium hydroxide, boron nitride, aluminium nitride, zinc oxide, aluminosilicate, graphite, and any mixture of these fillers. Preferably, filler **F**
20 comprises less than 15 wt.-% of chalk, based on the total weight of filler **F**, in particular less than 10 wt.-% of chalk, more preferably no chalk at all.

The filler **F** should be in powder form or at least particulate, in order to ensure homogeneous compounding in its high amounts.
25

Preferably, the composition comprises more than 75 wt.-%, preferably more than 80 wt.-%, in particular more than 85 wt.-%, based on the total composition, of said filler **F**.

30 In preferred embodiments of the moisture-curable composition according to present invention, the filler **F** comprises or consists of aluminium oxide and aluminium hydroxide. This combination has the advantage that it shows

especially good thermal conductivity and at the same time excellent flame-retardant properties. This makes it especially suitable for battery assemblies.

It is preferred to use more than one type of filler **F**, for example aluminium
5 oxide and aluminium hydroxide, with different particle sizes. For example, it is advantageous to use a bimodal or multimodal particle size range for the employed fillers. When at least one filler with relatively large particles and at least another one with relatively small particles are used together, a higher density of close-packing of spheres may be achieved, which is beneficial for
10 heat conductivity and compounding when using small amounts of reactive polymer **P** and high amounts of filler **F**.

The moisture-curable composition furthermore comprises at least one dispersion additive **D**. Dispersion additives are well known in the field of
15 coating formulations containing fillers and pigments. They are also known as dispersants or wetting agents and facilitate the compounding of solids into a liquid matrix. In principle all common dispersion additives are suitable, and their suitable amount for a given formulation depends on the type of dispersion additive and relative amount of filler **F** and other constituents, such as polymer
20 **P**. In preferred embodiments, the composition comprises said dispersion additive **D** with an amount of between 0.5 and 5.0 wt.-%, preferably between 0.7 and 4.0 wt.-%, in particular between 1.0 and 3.0 wt.-%, based on the total composition.

25 An especially preferred dispersion additive **D** is an ammonium salt or alkyl ammonium salt of a polymer or copolymer containing carboxylate and/or phosphate groups, preferably a polyether and/or polyester polymer containing carboxylate and/or phosphate groups.

30 Suitable such dispersion additives **D** are, for example, Byk-W 996, Byk-W 969, Byk-W 985 (available from Altana) and Disparlon DA-234, DA-325, and DA-375 (available from King Industries).

The moisture-curable composition according to the present invention furthermore preferably comprises between 0.1 and 2.5 wt.-%, based on the total composition, organosilanes or oligomers of organosilanes, in particular monomeric or oligomeric organofunctional alkoxysilanes.

5

Organosilanes have various advantages. For example, they may act as desiccant or drying agent, in particular vinyl trimethoxysilane.

Other organosilanes have co-catalytic activity, in particular aminosilanes such
10 as 3-aminopropyl trimethoxysilane, and/or they act as adhesion promoters, such as 3-glycidoxypropyl trimethoxysilane. Nevertheless, in some embodiments the composition does not contain adhesion-promoting silanes, such as amino silanes or glycidoxy silanes. A composition free of adhesion-promoting silanes, in particular amino-functional and/or glycidoxy-functional
15 silanes, has the advantage that the composition may be easily removed from the substrate when the object bonded with the composition needs to be disassembled, for example during a battery replacement operation.

Preferred organosilanes acting, for example, as adhesion promoters and/or
20 crosslinkers are in particular aminosilanes, mercaptosilanes, epoxysilanes, (meth)acryloylsilanes, anhydridosilanes, carbamatosilanes, alkylsilanes or iminosilanes, oligomeric forms of these silanes, adducts formed from primary aminosilanes with epoxysilanes or (meth)acryloylsilanes or anhydridosilanes, amino-functional alkylsilsesquioxanes, 3-glycidoxypropyltrimethoxysilane, 3-
25 glycidoxypropyltriethoxysilane or 3-ureidopropyltrimethoxysilane, or oligomeric forms of these silanes.

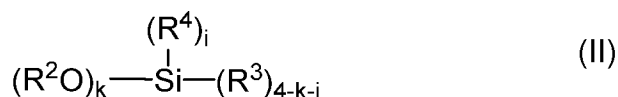
Preferred organosilanes acting as desiccants or drying agents are in particular tetraethoxysilane, vinyltrimethoxysilane, vinyltriethoxysilane or
30 organoalkoxysilanes having a functional group in the α -position to the silane group, especially N-(methyldimethoxysilylmethyl)-O-methylcarbamate, (methacryloyloxymethyl)silanes, and methoxymethylsilanes.

Preferred organosilanes acting as co-catalysts are in particular aminosilanes.

The organosilanes preferably comprised in the composition may be monomeric organosilanes or oligomeric organosilanes.

5

Examples of suitable monomeric organosilanes are shown in formula (II),



where

R^2 is a monovalent alkyl radical having 1 to 6 carbon atoms, preferably 1 or 2 carbon atoms, most preferably a methyl radical;

10 R^3 is a monovalent, linear or branched hydrocarbon radical having 1 to 20 carbon atoms and optionally containing olefinic, aromatic and/or cyclic moieties and optionally containing heteroatoms selected from O, N, S, and Si;

R^4 is a monovalent linear, branched, or cyclic alkyl or arakyl radical having 1 to 12 carbon atoms, preferably 1 to 8 carbon atoms, most preferably a methyl

15 radical;

index i is an integer with a value of 0 or 1, preferably 0;

index k is an integer with a value of 2 or 3, with the proviso that if $i = 1$ then $k = 2$.

20 In preferred embodiments, R^3 is an aminoalkyl radical selected from $-C_pH_{2p}-NH_2$,

$-C_pH_{2p}-NH-R^5$, $-C_pH_{2p}-NH-C_dH_{2d}-NH_2$, $-C_pH_{2p}-NH-C_dH_{2d}-NH-C_eH_{2e}-NH_2$,
 $-C_pH_{2p}-NH-C_dH_{2d}-NH-R^5$, and $-C_pH_{2p}-NH-C_dH_{2d}-NH-C_eH_{2e}-NH-R^5$;

where

25 R^5 is a monovalent linear, branched, or cyclic alkyl or arakyl radical having 1 to 12 carbon atoms, preferably 1 to 6 carbon atoms;

index p is an integer with a value of 1 to 6;

indices d and e are independently integers with a value of 2 to 6.

30 In other preferred embodiments, R^3 is a glycidoxyalkyl radical.

In further preferred embodiments, R^3 is a mercapto- or hydroxyalkyl radical.

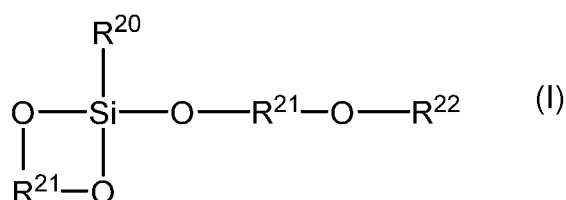
Suitable oligomeric silanes are linear, cyclic, or branched oligomers of the
 5 aforementioned monomeric organosilanes. They may be oligomers of one or
 more than one type of organosilane.

One advantage of using oligomeric organosilanes is that lower VOC levels can
 be achieved when employing them in greater amounts compared to purely
 monomeric silanes.

10 Preferred monomeric or oligomeric aminofunctional alkoxy silanes include N-(n-
 Butyl)-3-aminopropyltrimethoxysilane, 3-aminopropyltrimethoxysilane, 3-
 aminopropyl dimethoxymethyl-silane, N-(2-aminoethyl)-3-
 aminopropyltrimethoxysilane, N-(2-aminoethyl)-3-
 aminopropyl dimethoxymethylsilane, N-(2-aminoethyl)-N'-[3-(trimethoxysilyl)-
 15 propyl]ethylenediamine and oligomers obtained from the condensation of the
 mentioned aminosilanes, optionally oligomerized together with
 alkylalkoxy silanes, in particular methyltrimethoxysilane, ethyltrimethoxysilane,
 propyltrimethoxysilane, vinyltrimethoxysilane, n-butyltrimethoxysilane,
 isobutyltrimethoxysilane, phenyltrimethoxysilane, and octyltrimethoxysilane.
 20 Also preferred are monomeric or oligomeric or the analogs thereof with ethoxy
 in place of methoxy groups.

Preferred glycidoxymethyl functional organosilanes are
 glycidoxymethylpropyltrimethoxysilane and glycidoxymethylpropyltriethoxysilane and
 oligomers containing glycidoxymethyl groups, stemming from monomeric
 25 glycidoxymethylalkoxy silanes condensed with the aforementioned
 organosilanes or with themselves.

Especially preferred organosilanes comprised in the composition are those of
 the formula (I)



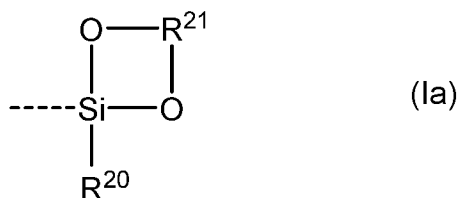
wherein

R²⁰ independently stands for a monovalent, optionally cyclic or branched, hydrocarbyl or heterocarbyl radical, optionally comprising aromatic moieties, which contains 1 to 12 carbon atoms and wherein the carbon atom next to the silicon atom either bonds via a C=C double bond to another carbon atom or

5 bonds to a heteroatom selected from O, N, and S;

R²¹ independently stands for a linear, cyclic, or branched divalent hydrocarbyl radical having 2 to 12 carbon atoms and optionally containing cyclic and/or aromatic moieties; and

10 R²² stands for a hydrogen atom or a group of the formula (Ia).



In preferred embodiments, each R²⁰ independently stands for a functional group selected from the group consisting of vinyl, phenyl, -CH₂-NH-cyclohexyl, -CH₂-methacrylate, and -CH₂-NH-(C=O)-O-CH₃.

15 Most preferably, R²⁰ is vinyl.

In the same or different preferred embodiments, each R²¹ stands for a linear or branched divalent hydrocarbyl radical having 2 to 10 carbon atoms. Even more preferred, each R²¹ independently is selected from the group consisting of

20 ethanediyl, the isomers of propanediyl, the isomers of butanediyl, the isomers of pentanediyl, the isomers of hexanediyl, cyclohexanediyl, the isomers of heptanediyl, the isomers of octanediyl, and the isomers of nonanediyl. Particularly preferred are the isomers of pentanediyl, in particular 2,2-dimethylpropanediyl.

25

R²² preferably stands for a group of the formula (Ia).

Suitable organosilanes according to formula (I) and their production are described in WO 2008/121360 A1. Suitable commercially available such

organosilanes are, for example, CoatOSil* T-Cure (Momentive) and Silquest* Y-15866 (Momentive).

The organosilanes of formula (I) have the advantage that they significantly improve curing rate and behavior of the compositions according to the present invention. Furthermore, they do not possess distinctly adhesion-promoting properties when used alone without any adhesion-promoting silanes such as amino- or epoxysilanes, which is advantageous in embodiments where the cured composition needs to be easily removable from the substrate.

An additional surprising beneficial effect of organosilanes of formula (I) is that their use prevents the formation of bubbles in the cured composition after storage under warm conditions. It was found that after application as a gap filler on aluminum or e-coated aluminum substrates (as used in battery boxes), the cured composition may show a tendency to form bubbles to a certain degree, if conventional monomeric organosilanes such as vinyl silanes are used. For oligomeric organosilanes, this effect was not observed.

In severe cases this bubble phenomenon may lead to decreased mechanical performance of the cured composition and it is aesthetically displeasing. By using organosilanes of formula (I) as main organosilane additive or sole organosilane additive, the bubble formation can be effectively prevented.

For avoiding bubble formation in the cured composition, it is preferred that the composition contains less than 0.1 wt.-% of monomeric organosilanes not according to formula (I).

The composition may comprise further constituents, especially the following auxiliaries and additives:

- additional desiccants or drying agents, especially orthoformic esters, calcium oxide or molecular sieves;
- additional plasticizers, especially reactive plasticizers in the form of monofunctional organic polymers or silanes, i.e. those that are silane-reactive only at one end;
- solvents;

- further inorganic or organic fillers, especially baryte (heavy spar), talcs, quartz flours, quartz sand, dolomites, wollastonites, kaolins, calcined kaolins, mica (potassium aluminum silicate), molecular sieves, magnesium hydroxide, silicas including finely divided silicas from pyrolysis processes,
- 5 industrially produced carbon blacks, metal powders such as iron or steel, PVC powder or hollow spheres;
- fibers, especially glass fibers, carbon fibers, metal fibers, ceramic fibers or polymer fibers such as polyamide fibers or polyethylene fibers;
- dyes;
- 10 – pigments, especially titanium dioxide or iron oxides;
- rheology modifiers, in particular thickeners or thixotropy additives, especially sheet silicates such as bentonites, derivatives of castor oil, hydrogenated castor oil, polyamides, polyurethanes, urea compounds, fumed (pyrogenic) silicas, cellulose ethers or hydrophobically modified polyoxyethylenes;
- 15 – stabilizers against oxidation, heat, light or UV radiation;
- natural resins, fats or oils such as rosin, shellac, linseed oil, castor oil or soya oil;
- non-reactive polymers that are preferably solid at room temperature such as, in particular, homo- or copolymers of unsaturated monomers, especially
- 20 from the group comprising ethylene, propylene, butylene, isobutylene, isoprene, vinyl acetate or alkyl (meth)acrylates, especially polyethylenes (PE), polypropylenes (PP), polyisobutylenes, ethylene-vinyl acetate copolymers (EVA) or atactic poly- α -olefins (APAO);
- flame-retardant substances, especially the already mentioned filler
- 25 aluminum hydroxide, magnesium hydroxide, or, in particular, the already mentioned organic phosphoric esters such as, in particular, triethyl phosphate, tricresyl phosphate, triphenyl phosphate, diphenyl cresyl phosphate, isodecyl diphenyl phosphate, tris(1,3-dichloro-2-propyl) phosphate, tris(2-chloroethyl) phosphate, tris(2-ethylhexyl) phosphate,
- 30 tris(chloroisopropyl) phosphate, tris(chloropropyl) phosphate, isopropylated triphenyl phosphate, mono-, bis- or tris(isopropylphenyl) phosphates of different degrees of isopropylation, resorcinol bis(diphenyl phosphate), bisphenol A bis(diphenyl phosphate) or ammonium polyphosphates;

- surface-active substances, especially leveling agents, deaerating agents or defoamers;
 - biocides, especially algicides, fungicides or substances that inhibit fungal growth;
- 5 and other substances customarily used in curable compositions. It may be advisable to chemically or physically dry certain constituents before mixing them into the composition.

10 In preferred embodiments of the moisture-curable composition according to the invention, the composition does not contain polydiorganosiloxanes.

The composition is preferably produced and stored with exclusion of moisture. Typically, it is storage-stable with exclusion of moisture in a suitable package or arrangement, such as, more particularly, a bottle, a canister, a pouch, a
15 bucket, a vat or a cartridge.

The composition may take the form of a one-component or of a multi-component, especially two-component, composition.

In the present document, “one-component” refers to a composition in which all
20 constituents of the composition are stored in a mixture in the same container and which is curable with moisture, in particular moisture from air humidity. In these cases, it is preferred that the fillers **F** are dried prior to formulating the composition in order to ensure sufficient storage stability.

25 In the present document, “two-component” refers to a composition in which the constituents of the composition are present in two different components which are stored in separate containers. Normally, the reactive species, i.e. polymer **P** and organosilane, are stored in the first component, and water is present in the second component. Only shortly before or during the application of the
30 composition are the two components mixed with one another, whereupon the mixed composition cures under the action of moisture from air humidity and/or from the second component.

Any second or optionally further components is/are mixed with the first component prior to or on application, especially by means of a static mixer or by means of a dynamic mixer.

In the case of a two-component composition, it is still preferable to dry the filler **F** in the first component in order to ensure storage stability. The fillers of the second component, however, do not have this restriction.

Advantages of a one-component formulation include an easier application process for the user with no mixing steps involved and no risk of mixing errors.

Advantage of a two-component formulation include a generally higher storage stability, no requirement to dry the fillers **F** of the second component, and a faster, more homogeneous deep-curing behavior due to immediately present water within the mixture after mixing (no need for humidity to diffuse into the mixture).

In preferred embodiments of the moisture-curable composition according to the present invention, the composition therefore consists of two individual components **A** and **B** that are stored in separated containers and mixed before or during applications to yield the moisture-curable composition, wherein said component **A** contains polymer **P** and optionally organosilanes; said component **B** contains water; and all other constituents of the composition may be present in either one or both of the components **A** and **B**.

An especially preferred embodiment of a two-component moisture-curable composition according to the present invention consists of a component **A** comprising, based on component **A**,

- between 1.2 and 9 wt.-%, preferably between 2 and 8 wt.-%, of said polymer **P**;
- between 0.3 and 2.0 wt.-%, preferably between 0.5 and 1.8 wt.-%, of at least one organosilane or oligomers thereof;
- between 4 and 10 wt.-% of said plasticizer **PL**;
- between 80 and 93 wt.-% of said at least one filler **F**;

- between 1 and 3 wt.-% of said dispersion agent **D**;
- and a component **B**, comprising, based on component **B**,
- between 3 and 10 wt.-% of said plasticizer **PL**;
- between 85 and 95 wt.-% of said at least one filler **F**;
- 5 - between 0.5 and 3 wt.-% of said dispersion agent **D**;
- between 0.5 and 2.5 wt.-% of water;
- between 0 and 1.5 wt.-%, preferably between 0.1 and 1 wt.-% of said catalyst for the curing of silane-functional polymers.

- 10 A preferred volumetric mixing ratio of component **A** to component **B** for above two-component composition is between 1:2 and 2:1, preferably between 1:1.5 and 1.5:1, in particular between 1:1.2 and 1.2:1, most preferably 1:1.

The water mentioned for component **B** may be added accordingly, or it may be
15 present from the beginning as impurity in not previously dried fillers **F**. Fillers **F** normally contain, if not dried, up to 1 wt.-% or more of water bound to their surface or within pores. This water is normally not chemically bound but only physisorbed and is able to promote the crosslinking of the polymers when the composition is mixed. Depending on the type and dryness of fillers **F** used,
20 however, it may be advantageous to add water to component **B**, preferably in the above specified amounts.

All the preferred embodiments described for the individual constituents, e.g. polymer **P** or organosilane, of above two-component composition are the same
25 as described in a more general manner further above in the description.

The curable composition according to the present invention is preferably applied at ambient temperature, such as room temperature, preferably within a temperature range between 0°C and 45°C, especially 5°C to 35°C, and cures
30 under these conditions.

On application, the crosslinking reaction of the silane groups commences, if appropriate under the influence of moisture. Silane groups present can condense with silanol groups present to give siloxane groups (Si-O-Si groups).

Silane groups present can also be hydrolyzed on contact with moisture to give silanol groups (Si-OH groups) and form siloxane groups (Si-O-Si groups) through subsequent condensation reactions. As a result of these reactions, the composition ultimately cures. The catalysts described further above accelerate this curing mechanism catalytically.

If external water is required for the curing, especially in the case of one-component compositions, this can either come from the air (air humidity), or else the composition can be contacted with a water-containing component, for example by painting, for example with a smoothing agent, or by spraying, or water or a water-containing component can be added to the composition on application, for example in the form of a water-containing or water-releasing liquid or paste. A paste is especially suitable if the composition itself is in the form of a paste.

In the case of curing by means of air humidity, the composition cures from the outside inward, at first forming a skin on the surface of the composition. What is called the "skin time" or "skin formation time" is a measure of the curing rate of the composition. The speed of curing is generally determined by various factors, for example the availability of water (e.g., relative air humidity), temperature, etc.

The composition is in principle suitable for a multitude of uses, for example a molding, elastomer, film or membrane, as a potting compound, sealant, gap filler, adhesive, covering, or coating for construction and industrial applications, for example as a seam seal, cavity seal, electrical insulation compound, assembly adhesive, bodywork adhesive, seal, or gap filler. The composition is particularly suitable as an adhesive, gap filler, and/or sealant, especially in automotive manufacturing, for batteries, electronic elements, engine control units, anti-lock braking and electronic stability control and safety systems, DC/DC converter of hybrid electric vehicles, advanced driver-assistance systems, sensors, or control units.

For an application as adhesive, gap filler, or sealant, the composition preferably has a pasty consistency with structurally viscous properties. Such a

pasty sealant or adhesive is especially applied to a substrate from standard cartridges which are operated manually, by means of compressed air or with a battery, or from a vat or hobcock by means of a delivery pump or an extruder, optionally by means of an application robot.

5

On application, the composition is preferably applied to at least one substrate. Suitable substrates are especially

- glass, glass ceramic, concrete, mortar, brick, tile, gypsum and natural rocks such as limestone, granite or marble;
- 10 – metals and alloys such as aluminum, iron, steel and nonferrous metals, and also surface-finished metals and alloys such as galvanized or chromed metals or surface coated metals, such as Kynar®- or Duranar®-coated aluminum;
- leather, textiles, paper, wood, woodbase materials bonded with resins, for
- 15 example phenolic, melamine or epoxy resins, resin-textile composites and further polymer composites;
- plastics such as polyvinyl chloride (rigid and flexible PVC), acrylonitrile-butadiene-styrene copolymers (ABS), polycarbonate (PC), polyamide (PA), polyesters, poly(methyl methacrylate) (PMMA), epoxy resins, polyurethanes
- 20 (PUR), polyoxymethylene (POM), polyolefins (PO), polyethylene (PE) or polypropylene (PP), ethylene/propylene copolymers (EPM) and ethylene/propylene/diene terpolymers (EPDM), and also fiber-reinforced plastics such as carbon fiber-reinforced plastics (CFP), glass fiber-reinforced plastics (GFP) and sheet molding compounds (SMC), where the plastics
- 25 may have been surface-treated by means of plasma, corona or flames;
- coated substrates such as powder-coated metals or alloys;
- electrocoated (e-coat) surfaces coated by electrophoretic painting processes;
- paints or varnishes, especially automotive topcoats.

30

If required, the substrates can be pretreated prior to the application of the composition, especially by chemical and/or physical cleaning methods or by

the application of an adhesion promoter, an adhesion promoter solution or a primer.

In general, it is not required to pre-treat the surfaces prior to application of the composition. The composition shows in preferred embodiments an excellent
5 adhesion profile on a large variety of unprimed, non-pretreated, and even uncleaned materials. In other preferred embodiments, the composition shows good adhesion, but can be easily removed by pulling. These compositions preferably do not contain adhesion promoting organosilanes as described further above.

10

It is possible to bond or seal two identical or two different substrates, especially the aforementioned substrates.

After the curing of the composition with water, especially in the form of air
15 humidity, and/or with at least one suitable crosslinker, a cured composition is obtained.

The compositions disclosed herein possess excellent thermal conductivity, in particular of ≥ 2 W/mK, in preferred embodiments of ≥ 2.5 W/mK, according to
20 ASTM D5470.

The compositions disclosed herein generally possess low viscosities of less than 1000 Pa s at a shear rate of 1 s^{-1} .

25 Furthermore, the compositions disclosed herein have the advantage of good compressibility, good sag resistance and good flame retardant properties.

Another aspect of the present invention is the use of an adhesive composition as described herein to adhesively bond, coat, or seal substrates.

30

In preferred embodiments of said use, at least one of these substrates is a battery or an electric or electronic device or electronic element.

The use of the composition gives rise to an article that was bonded, sealed, or coated with the composition. The article is especially a built structure, especially a structure built by structural engineering or civil engineering, an industrially manufactured good or a consumable good, especially a domestic
5 appliance or a mode of transport such as, more particularly, an automobile, a bus, a truck, a rail vehicle, a ship, an aircraft, a drone, or a helicopter; or the article may be an installable component thereof.

Another aspect of the present invention is thus a substrate, adhesively sealed,
10 coated, or bonded by an adhesive composition described herein.

Examples

Adduced hereinafter are working examples which are intended to elucidate the invention described in detail. It will be appreciated that the invention is not
15 restricted to these described working examples.

The term "standard climatic conditions" refers to a temperature of $23\pm 1^{\circ}\text{C}$ and a relative air humidity of $50\pm 5\%$.

Test methods:

20 **Viscosity** was determined on a MCR 302 rheometer (Anton Paar) according to ISO 3219. Measurement parameters were: Rotation $0.1 - 10 \text{ s}^{-1}$, measurement point at 10 s^{-1} , temperature 20°C , gap 0.5 mm .

Thermal conductivity was determined according to ASTM D5470-12 on
25 samples cured during 7 days under standard climatic conditions. For the measurements, a TIM (thermal interface material) testing device (Zentrum für Wärmemanagement, Stuttgart, Germany) using the stationary cylinder method was used. Sample dimensions were: Diameter 30 mm , thickness 2 mm . The pressure parameter of the measurements were 1, 2, 3, 5, 7, 10 bar .

Compounds used:

Name	Description, trade name
STP-E30 (polymer P)	Polyether polymer having dimethoxy(methyl)silylmethylcarbamate end groups (Geniosil® STP-E30, Wacker)
STP-E10 (polymer P)	Polyether polymer having dimethoxy(methyl)silylmethylcarbamate end groups (Geniosil® STP-E10, Wacker)
Organosilane 1	Silane according to formula (I) with R ²⁰ = vinyl, R ²¹ = 2,2-dimethylpropanediyl, and R ²² = group of formula (Ia) (Silquest® Y-15866, Momentive)
Organosilane 2	Vinyltrimethoxysilane (Silquest® A-171, Momentive)
Apyral 20X (filler F)	Aluminium hydroxide (Al(OH) ₃) (Apyral® 20X, Nabaltec);
Apyral 1E (filler F)	Aluminium hydroxide (Al(OH) ₃) (Apyral® 1E, Nabaltec);
Martoxid TM 3310 (filler F)	Aluminium oxide (α -Al ₂ O ₃) (Martoxid® TM 3310, Huber Martinswerk);
Omyacarb 40 GU (filler F)	Ground natural calcium carbonate (Omyacarb® 40, Omya)
TOF (plasticizer PL)	Tris-(2-Ethylhexyl)-phosphate (Disflamoll® TOF, Lanxess)
Byk-W 969 (dispersion agent D)	30-50 wt.-% solution of a hydroxy-functional alkylammonium salt of an acidic copolymer in 2-phenoxyethanol (BYK-W 969, Altana)
Curing catalyst	1,8-Diazabicyclo[5.4.0]undec-7-ene (DBU) (3 wt.-% in Hexamoll® DINCH plasticizer)
Antioxidant	High molecular weight sterically hindered phenolic antioxidant (Irganox® 1076, BASF)
Silica	Hydrophilic pyrogenic silica (Aerosil® 200, Evonik)

Table 1: Compounds used for the example compositions.

Compositions based on polymers containing reactive silane groups:

Comparative examples (not according to the present invention) are identified in Tables 2 to 6 by “(Ref.)”.

A series of example two-component compositions was prepared by mixing the ingredients of each respective component **A** and **B** shown in Tables 2 and 5 (components **A**) and Tables 3 and 6 (components **B**) in the indicated sequence as listed in the table under nitrogen atmosphere in a vacuum mixer until homogeneous pastes were obtained. The individual components **A** and **B** were filled into internally coated aluminum spreading piston cartridges that were closed airtight and stored under standard climate conditions for at least 24 h until the testing protocol (i.e. viscosity) was employed. For heat conductivity testing of the cured compositions, the respective components **A** and **B** of the compositions were mixed in a volume ratio of 1:1 and subsequently left for curing during 7 days under standard climate. The test results of these 1:1 mixtures are shown in Table 4 for selected compositions.

Composition (components A)	C1-A	C2-A	C3-A	C4-A	C5-A (Ref.)	C6-A (Ref.)	C7-A (Ref.)
STP-E30 (polymer P)	6	5	4	3.5	5	8	15
Organosilane 1	0.5	1	1	1	0.5	0.5	0.5
Apyral 20X (filler F) (dried)	40	27	27	-	-	-	-
Apyral 1E (filler F) (dried)	-	-	-	15	-	-	-
Martoxid TM 3310 (filler F) (dried)	43	60	61	74	-	-	-
Omyacarb 40 GU (filler F) (dried)	-	-	-	-	85	80	70
TOF (plasticizer PL)	8.5	5	5	4.5	7.5	9.5	12.5
Byk-W 969 (dispersion agent D)	2	2	2	2	2	2	2

Table 2: Example compositions components **A** (all numbers in wt.-%, based on the total individual composition **A**).

Composition (components B)	C1-B	C2-B	C3-B	C4-B	C5-B (Ref.)	C6-B (Ref.)	C7-B (Ref.)
TOF (plasticizer PL)	7	5	4	4	12.5	17.5	27.5
Apyral 20X (filler F)	40	31	32	-	-	-	-
Apyral 1E (filler F)	-	-	-	20.5	-	-	-
Martoxid TM 3310 (filler F)	49.7	60	60	72	-	-	-
Omyacarb 40 GU (filler F)	-	-	-	-	85	80	70
Water	1	1	1	1	1	1	1
Byk-W 969 (dispersion agent D)	2	2	2	2	2	2	2
Curing catalyst	0.3	1	1	0.5	0.5	0.5	0.5

Table 3: Example compositions components **B** (all numbers in wt.-%, based on the total individual composition **B**).

Test results compositions A+B (1:1 volume mixture)	C1-A + C1-B	C2-A + C2-B	C3-A + C3-B	C4-A + C4-B	C5-A + C5-B (Ref.)	C6-A + C6-B (Ref.)	C7-A + C7-B (Ref.)
Viscosity component A (1 s ⁻¹)	n/m	903	865	886	n/m	n/m	n/m
Viscosity component B (1 s ⁻¹)	n/m	205	237	199	n/m	n/m	n/m
Thermal conductivity (W/mK)	2.23	2.6	2.9	2.95	1.02	0.84	0.57

Table 4: Testing results of the investigated samples. "n/m" means not measured.

5

To investigate the lowest amount of polymer **P** required for proper curing, a series of low polymer **P** compositions was prepared with the method described above and using the ingredients and amounts detailed in Tables 5 and 6. The results of the hardening (curing) behavior are shown in Table 7.

Composition (components A)	C8-A	C9-A	C10-A	C11-A	C12-A	C13-A (Ref.)
STP-E10 (polymer P)	2	1.8	1.6	1.4	1.2	1.0
Organosilane 1	0.4	0.4	0.4	0.4	0.4	0.4
Martoxid TM 3310 (filler F) (dried)	60	60	60	60	60	60
Apyral 1E (filler F) (dried)	30.6	30.6	30.6	30.6	30.6	30.6
TOF (plasticizer PL)	6.0	6.2	6.4	6.6	6.8	7.0
Byk-W 969 (dispersion agent D)	1	1	1	1	1	1

Table 5: Example compositions components **A** (all numbers in wt.-%, based on the total individual composition **A**).

Composition (components B)	C8-B	C9-B	C10-B	C11-B	C12-B	C13-B (Ref.)
TOF (plasticizer PL)	6	6	6	6	6	6
Byk-W 969 (dispersion agent D)	1	1	1	1	1	1
Martoxid TM 3310 (filler F)	67.2	67.2	67.2	67.2	67.2	67.2
Apyral 1E (filler F)	25.5	25.5	25.5	25.5	25.5	25.5
Silica	0.3	0.3	0.3	0.3	0.3	0.3

Table 6: Example compositions components **B** (all numbers in wt.-%, based on the total individual composition **B**).

All mixtures of Table 7 did cure into pasty, useful products, except the Reference example C13A + C13B. This did not fully cure and remained inhomogeneous and with poor cohesion.

Test results compositions A+B (1:1 volume mixture)	C8-A + C8-B	C9-A + C9-B	C10-A + C10-B	C11-A + C11-B	C12-A + C12-B	C13-A + C13-B (Ref.)
Curing behavior	OK	OK	OK	OK	OK	Not OK ¹

Table 7: Results of curing behavior test of compositions based on C8-A to C13-A and C8-B to C13-B mixed in a 1:1 volume ratio. ¹ did not cure properly.

Additional experiments were done comparing different organosilanes. The compositions are shown in Tables 8 and 11 (**A** components) and Tables 9 and 12 (**B** components). Preparation and storage of the individual components was done as according to the procedure defined above for, e.g., the components **A** and **B** in Tables 2 and 3.

Composition (components A)	C14-A	C15-A	C16-A	C17-A	C18-A
STP-E10 (polymer P)	2	2	2	2	2
Organosilane 1	0.8	0.5	0.3	-	-
Organosilane 2	-	-	-	0.8	0.5
Martoxid TM 3310 (filler F) (dried)	70	70	70	70	70
Apyral 1E (filler F) (dried)	20	20	20	20	20
Antioxidant	0.2	0.2	0.2	0.2	0.2
TOF (plasticizer PL)	6.0	6.3	6.5	6.6	6.8
Byk-W 969 (dispersion agent D)	1	1	1	1	1

Table 8: Example compositions components **A** (all numbers in wt.-%, based on the total individual composition **A**).

Composition (components B)	C14-B	C15-B	C16-B	C17-B	C18-B
TOF (plasticizer PL)	7	7	7	7	7
Water	0.5	0.5	0.5	0.5	0.5
Byk-W 969 (dispersion agent D)	1	1	1	1	1
Apyral 1E (filler F)	24.5	24.5	24.5	24.5	24.5
Martoxid TM 3310 (filler F)	67	67	67	67	67

Table 9: Example compositions components **B** (all numbers in wt.-%, based on the total individual composition **B**).

- These compositions of s Tables 8 and 11 (**A** components) and Tables 9 and 12
- 5 (**B** components) were mixed according to the weight mixing ratios and individual components as shown in Tables 10 and 13. In the latter Tables, the thermal conductivity and the tack free time as measured by the methods defined above, as well as the bubble formation are shown.
- 10 The bubble formation was assessed by eye on samples that were cured first during 7 days at 23 °C and 50% r.h. and subsequently at 7 days in a 90 °C oven and then cooled to 23 °C and cut open. After curing open, the amount of bubbles visible to the eye was assessed by the following rating:
- 0 = no visible bubbles
- 15 1 = only very few bubbles visible
- 2 = significant amount of bubbles visible
- 3 = large amount of bubbles visible.

Test results compositions A+B (100:103 weight/weight mixture)	C14-A + C14-B	C15-A + C15-B	C16-A + C16-B	C17-A + C17-B	C18-A + C18-B
Tack free time (h)	6	4	3	>10	>10
Bubble formation	0	0	0	3	3
Thermal conductivity (W/mK)	2.9	2.9	2.9	2.9	2.9

Table 10: Testing results of the investigated samples. "n/m" means not measured.

Composition (components A)	C19-A	C20-A	C21-A	C22-A	C23-A
STP-E10 (polymer P)	2	2	2	2	2
Organosilane 1	-	0.5	0.3	0.5	0.3
Organosilane 2	0.3	0.1	0.1	0.2	0.2
Martoxid TM 3310 (filler F) (dried)	70	70	70	70	70
Apyral 1E (filler F) (dried)	20	20	20	20	20
Antioxidant	0.2	0.2	0.2	0.2	0.2
TOF (plasticizer PL)	6.5	6.2	6.4	6.1	6.3
Byk-W 969 (dispersion agent D)	1	1	1	1	1

Table 11: Example compositions components A (all numbers in wt.-%, based on the total individual composition A).

Composition (components B)	C19-B	C20-B	C21-B	C22-B	C23-B
TOF (plasticizer PL)	7	7	7	7	7
Water	0.5	0.5	0.5	0.5	0.5
Byk-W 969 (dispersion agent D)	1	1	1	1	1
Apyral 1E (filler F)	24.5	24.5	24.5	24.5	24.5
Martoxid TM 3310 (filler F)	67	67	67	67	67

Table 12: Example compositions components B (all numbers in wt.-%, based on the total individual composition B).

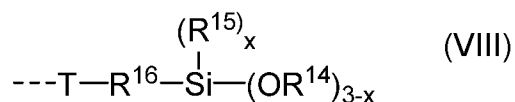
Test results compositions A+B (100:103 weight/weight mixture)	C19-A + C19-B	C20-A + C20-B	C21-A + C21-B	C22-A + C22-B	C23-A + C23-B
Tack free time (h)	8	4	3	5	4
Bubble formation	2	0	0	1	1
Thermal conductivity (W/mK)	2.9	2.9	2.9	2.9	2.9

Table 13: Testing results of the investigated samples.

Claims

1. A moisture-curable composition, comprising
- between 0.6 and 15.0 wt.-%, based on the total composition, of at least one organic polymer **P** containing reactive silane groups;
 - between 70 and 95 wt.-%, based on the total composition, of at least one filler **F**;
 - at least one dispersion additive **D**;
 - optionally at least one catalyst for the curing of silane-functional polymers;
 - up to 10 wt.-%, based on the total composition, of at least one plasticizer **PL**;
- characterized in that
- said filler **F** is selected from the list consisting of aluminium oxide, aluminium hydroxide, boron nitride, aluminium nitride, zinc oxide, silver, copper, aluminium, chalk, aluminosilicate, graphite, and any mixture of these fillers; with the proviso that the amount of chalk in the filler **F** does not exceed 25 wt.-% of the total amount of filler **F**.
2. The moisture-curable composition as claimed in claim 1, characterized in that the composition comprises less than 12.5 wt.-%, preferably less than 10 wt.-%, more preferably less than 7.5 wt.-%, in particular less than 5 wt.-%, based on the total composition, of said polymer **P** containing reactive silane groups.
3. The moisture-curable composition as claimed in claim 1 or 2, characterized in that the composition comprises more than 75 wt.-%, preferably more than 80 wt.-%, in particular more than 85 wt.-%, based on the total composition, of said filler **F**.
4. The moisture-curable composition as claimed in any of claims 1 to 3, characterized in that the filler **F** comprises or consists of aluminium oxide and aluminium hydroxide.

5. The moisture-curable composition as claimed in any of claims 1 to 4, characterized in that the composition comprises said dispersion additive **D** with an amount of between 0.5 and 5.0 wt.-%, based on the total composition.
6. The moisture-curable composition as claimed in any of claims 1 to 5, characterized in that said dispersion additive **D** is an amine or ammonium salt of a polymer or copolymer containing carboxylate and/or phosphate groups, preferably a polyether and/or polyester polymer containing carboxylate and/or phosphate groups.
7. The moisture-curable composition as claimed in any of claims 1 to 6, characterized in that said plasticizer **PL** comprises or consists of a trialkyl and/or triaryl phosphate.
8. The moisture-curable composition as claimed in any of claims 1 to 7, characterized in that said polymer **P** has end groups of the formula (VIII)



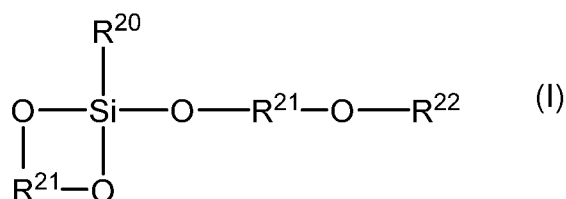
wherein

- R^{16} is a linear or branched divalent hydrocarbyl radical having 1 to 12 carbon atoms, preferably a methylene radical;
- T is a divalent radical selected from ---O--- , ---S--- , $\text{---N(R}^{17})\text{---}$, $\text{---O---CO---N(R}^{17})\text{---}$, $\text{---N(R}^{17})\text{---CO---O---}$ and $\text{---N(R}^{17})\text{---CO---N(R}^{17})\text{---}$, where R^{17} is a hydrogen radical or a linear or branched hydrocarbyl radical which has 1 to 20 carbon atoms and optionally has cyclic moieties;
- R^{14} is a methyl or ethyl radical;
- R^{15} is a methyl radical; and
- x is 0 or 1.

9. The moisture-curable composition as claimed in any of claims 1 to 8, characterized in that the composition furthermore comprises between 0.1 and 2.5 wt.-%, based on the total composition, organosilanes or oligomers of organosilanes.

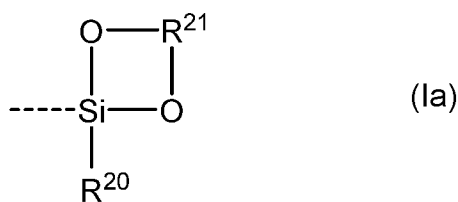
5

10. The moisture-curable composition as claimed in claim 9, characterized in that said organosilane comprises or consists of an organosilane of the formula (I)



wherein

- 10 R^{20} independently stands for a monovalent, optionally cyclic or branched, hydrocarbyl or heterocarbyl radical, optionally comprising aromatic moieties, which contains 1 to 12 carbon atoms and wherein the carbon atom next to the silicon atom either bonds via a C=C double bond to another carbon atom or bonds to a heteroatom
- 15 selected from O, N, and S;
- R^{21} independently stands for a linear, cyclic, or branched divalent hydrocarbyl radical having 2 to 12 carbon atoms and optionally containing aromatic moieties; and
- R^{22} stands for a hydrogen atom or a group of the formula (Ia).



20

11. The moisture-curable composition as claimed in any of claims 1 to 10, characterized in that the composition does not contain polydiorganosiloxanes.

12. The moisture-curable composition as claimed in any of claims 1 to 11, characterized in that the composition consists of two individual components **A** and **B** that are stored in separated containers and mixed before or during applications to yield the moisture-curable composition, wherein said component **A** contains polymer **P** and optionally organosilanes; said component **B** contains water; and all other constituents of the composition may be present in either one or both of the components **A** and **B**.
- 10 13. The moisture-curable composition as claimed in claim 12, characterized in that said component **A** comprises, based on component **A**,
- between 1.2 and 9 wt.-% of said polymer **P**;
 - between 0.3 and 2.0 wt.-% of at least one organosilane or oligomers thereof;
 - 15 - between 4 and 10 wt.-% of said plasticizer **PL**;
 - between 80 and 93 wt.-% of said at least one filler **F**;
 - between 1 and 3 wt.-% of said dispersion agent **D**;
- and said component **B** comprises, based on component **B**,
- between 3 and 10 wt.-% of said plasticizer **PL**;
 - 20 - between 85 and 95 wt.-% of said at least one filler **F**;
 - between 1 and 3 wt.-% of said dispersion agent **D**;
 - between 0.5 and 2.5 wt.-% of water;
 - between 0 and 1.5 wt.-% of said catalyst for the curing of silane-functional polymers.
- 25 14. Use of a moisture-curable composition according to any of claims 1 to 13 to adhesively bond, coat, or seal substrates.
15. The use according to claim 14, characterized in that at least one of the
- 30 substrates is a battery or an electronic device.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/053659

A. CLASSIFICATION OF SUBJECT MATTER		
INV. C08K5/00	C08K3/013	C08K3/22
C08K3/38	C08K3/28	C08K3/08
C08K5/5419	C08K3/34	
C08K3/26	C08K3/04	C08L71/02
	C08K5/521	
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) C08K		
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) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/166859 A1 (CHOFFAT FABIEN [CH] ET AL) 18 June 2015 (2015-06-18)	1-9, 11-14
A	page 1, paragraph 6; claims page 6, paragraphs 94-98,101; examples	10,15
A	US 2008/312369 A1 (BEERS MELVIN DALE [US] ET AL) 18 December 2008 (2008-12-18)	1-15
	page 1, paragraphs 5,8 page 5, paragraph 46-47; examples	
A	DATABASE WPI Week 201413 Thomson Scientific, London, GB; AN 2014-C42653 XP002793017, & JP 2014 024958 A (KANEKA CORP) 6 February 2014 (2014-02-06) abstract	1-13
	----- -/-	
☒ 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 another 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 7 April 2020		Date of mailing of the international search report 20/04/2020
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Masson, Patrick

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/053659

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI Week 201323 Thomson Scientific, London, GB; AN 2013-E28554 XP002793018, & WO 2013/042638 A1 (THREE BOND CO LTD) 28 March 2013 (2013-03-28) abstract -----	1-15
A	DATABASE WPI Week 201511 Thomson Scientific, London, GB; AN 2015-08744X XP002793019, & JP 2015 013927 A (ADEKA CORP) 22 January 2015 (2015-01-22) abstract -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2020/053659

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015166859	A1	18-06-2015	AU 2013288572 A1 29-01-2015
			CN 104428333 A 18-03-2015
			EP 2872541 A1 20-05-2015
			JP 2015528033 A 24-09-2015
			US 2015166859 A1 18-06-2015
			WO 2014009557 A1 16-01-2014
US 2008312369	A1	18-12-2008	AU 2005258323 A1 05-01-2006
			CA 2571870 A1 05-01-2006
			CN 101010398 A 01-08-2007
			CN 102443266 A 09-05-2012
			EP 1920018 A2 14-05-2008
			EP 3168272 A1 17-05-2017
			HK 1104932 A1 28-03-2014
			JP 5356686 B2 04-12-2013
			JP 2008504407 A 14-02-2008
			KR 20070041725 A 19-04-2007
			US 2005288415 A1 29-12-2005
			US 2008312369 A1 18-12-2008
			WO 2006002425 A2 05-01-2006
JP 2014024958	A	06-02-2014	NONE
WO 2013042638	A1	28-03-2013	CN 103998528 A 20-08-2014
			JP W02013042638 A1 26-03-2015
			KR 20140063722 A 27-05-2014
			WO 2013042638 A1 28-03-2013
JP 2015013927	A	22-01-2015	NONE