Some commercially available potting silicones include one component compositions such as U.S. Patent 4,271,425 which are cured by moisture, requiring from several hours to days to complete the cure. Faster cures may be obtained from two component systems such as those in U.S. Patent 4,087,585 if elevated temperatures are provided. The two-component systems which require a platinum catalyst, however, are inhibited by organotin compounds, sulfur, amines, urethanes and unsaturated hydrocarbon plasticizers on the substrate surfaces.

Most systems crosslinkable in two ways are based on UV curing and curing under moisture, leading to undesired by-products for the applications. Some systems crosslinkable in two ways contain acrylate based product needing a radical polymerization, not being the best choice for the application.

WO2019088066 describes a hydrosilylable composition that can provide, during curing of same, a half-cured product which is stable; and a half-cured product and a cured product which are obtained using the hydrosilylable composition and which is also referring to the use of a one component system for pressure sensitive adhesive application which is not adequate for the potting application as the silicone composition should have enough pot life to allow its application according to the present invention.

SUMMARY

The following presents a summary of this disclosure to provide a basic understanding of some examples. This summary is intended to neither identify key or critical elements nor define any limitations of examples or claims. Furthermore, this summary may provide a simplified overview of some examples that may be described in greater detail in other portions of this disclosure.

Accordingly, it is desirable to use a silicone composition provided as a first part and a second part which will produce an elastomeric or soft gel consistency upon curing without the formation of by-products and avoiding radical polymerization for the potting of electronic components like PCB (printed circuit board) assemblies as well as switches and electronic connectors with pins having areas not accessible to photocurable curing. The silicone composition should be flowable enough to allow the correct filling into the electronic component with areas non accessible to photocuring. Furthermore, it is desirable that the composition be capable of curing by a further curing mechanism in areas of the curing cavity/chamber/mold which are not readily accessible to photocuring. Still further, when used on low energy substrates such as thermoplastics, the composition should display adequate adhesion over the substrate.

These technical problems are not adequately addressed and/or solved by the state of the art.

In an aspect, there is provided a potting compound for use in the potting of electronic equipment, the potting compound comprising a curable silicone composition the composition comprising:

(A) at least one polyorganosiloxane having at least one alkenyl groups bonded to a silicon atom,

(B) at least one organohydrogensiloxane having at least one SiH group,

(C1) at least one photo-activatable hydrosilylation catalyst,

(C2) at least one non-photo-activatable hydrosilylation catalyst, and

(D) optionally additives.

In another aspect, there is provided 25. A process of curing the curable silicone composition as defined above to a cured silicone composition in a chamber/cavity of the electronic component having areas not readily accessible to direct UV light irradiation, the process comprising:

a) applying the said curable silicone composition into the chamber/cavity in a manner so as to fill in the chamber/cavity.

b) irradiating the chamber/cavity with UV irradiation sufficient to substantially cure the composition in the areas directly accessible to UV light, and

c) exposing the composition on the chamber/cavity to a temperature of ≥ 20°C for sufficient time to cure the composition in the areas not accessible to UV light.

In another aspect, there is provided a process of curing of the curable silicone compositions as defined above to a cured silicone composition for the manufacture of connector potting, the process comprising

a) applying said curable silicone composition to a chamber/cavity/pocket comprising pin connectors,

b) exposing said curable silicone composition to UV light, and

c) then curing in areas not accessible to UV light in a temperature range of 20 to 80°C.

In another aspect, there is provided a cured composition obtained by the curing of the curable silicone composition as defined above by a UV radiation cure step followed by a cure step at a temperature in the range of ≥ 20°C and ≤80°C.

In another aspect, there is provided an article prepared by the steps, comprising:

I. mixing, so as to form a curable composition as defined above,

II. applying a potting of/dispensing said curable composition into a chamber/cavity of the electronic component; and

III. curing said curable composition to said chamber/cavity by exposing the said curable composition in the potting chamber/cavity to a source of UV radiation and thereafter non photoactivatable curing said curable composition at a temperature in the range of 20 to 80°C.

In another aspect, there is provided the use of the curable silicone composition, as defined above in the form of a kit of two parts system.

In another aspect, there is provided a composition comprising:

(a) a first part comprising (A) at least one polyorganosiloxane having at least one alkenyl group bonded to a silicon atom, (C1) at least one photo-activatable hydrosilylation catalyst, and (C2) at least one non-photo-activatable hydrosilylation catalyst, and

(b) a second part comprising (B) at least one organohydrogensiloxane having at least one SiH group, and (D1) a polyorganosiloxane, different from (B)comprising at least one unit selected from the group consisting of

$R(H)SiO_{2/2}$ and

$R^5(R)SiO_{2/2}$,

wherein R is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation, R^5 is selected from the group consisting of unsaturated aliphatic group with up to 14 carbon atoms, epoxy–group-containing aliphatic group with up to 14 carbon atoms, cyanurate–containing group, and an isocyanurate–containing group, and

further comprising at least one unit of the formula (3):

$$- O_{2/2}(R)Si\text{-}R^4\text{-}SiR_d(OR^3)_{3-d} \qquad (3)$$

wherein

R in formula (3) may be identical or different and is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation,,

R^3 is selected from H (hydrogen) and alkyl radicals having 1 to 6 carbon atoms, and may be identical or different,

R^4 is a difunctional optionally substituted hydrocarbyl radical with up to 15 carbon atoms, which may contain one or more heteroatoms selected from O, N and S atoms, and which is bond to the silicon atoms via an Si-C-bond, and

d is 0 to 2.

In another aspect, there is provided a process of curing the curable silicone composition as defined above in a chamber/cavity of an electronic component having areas not readily accessible to direct UV light irradiation, the process comprising:

(i) combining part (a) and part (b) to form the curable silicone composition;

(ii) applying the curable silicone composition into the chamber/cavity in a manner so as to fill in the chamber/cavity;

(iii) irradiating the chamber/cavity with UV irradiation sufficient to substantially cure the composition in the areas directly accessible to UV light; and

(iv) exposing the composition on the chamber/cavity to a temperature of $\geq 20°C$ for sufficient time to cure the composition in the areas not accessible to UV light.

In another aspect, there is provided a process of curing the curable silicone compositions as defined above to a cured silicone composition for the manufacture of connector potting or encapsulation of electronic components, the process comprising

(i) combining part (a) and part (b) to form the curable composition;

(ii) applying said curable silicone composition to a chamber/cavity/pocket comprising pin connectors,

(iii) exposing said curable silicone composition to UV light, and

(iv) curing in areas not accessible to UV light in a temperature range of 20 to 80°C.

In another aspect, there is provided an article prepared by the steps, comprising:

(i) mixing part (a) and part (b), so as to form a curable composition as defined above,

(ii) applying a potting of/dispensing of said curable composition into a chamber/cavity of the electronic component; and

(iii) curing said curable composition to said chamber/cavity by exposing the said curable composition in potting chamber/cavity to a source of UV radiation and thereafter non-photoactivatable curing said curable composition at a temperature in the range of 20 to 80°C.

In another aspect, there is provided a composition comprising:

(A) at least one polyorganosiloxane having at least one, alkenyl groups bonded to a silicon atom,

(B) at least one organohydrogensiloxane having at least one SiH group,

(C1) at least one photo-activatable hydrosilylation catalyst,

(C2) at least one non-photo-activatable hydrosilylation catalyst, and

(D1) A polyorganosiloxane comprising at least one unit selected from the group consisting of

$R(H)SiO_{2/2}$ and

$R^5(R)SiO_{2/2}$,

wherein R is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation, R^5 is selected from the group consisting of unsaturated aliphatic group with up to 14 carbon atoms, epoxy–group-containing aliphatic group with up to 14 carbon atoms, cyanurate–containing group, and an isocyanurate–containing group, and

further comprising at least one unit of the formula (3):

$$-O_{2/2}(R)Si\text{-}R^4\text{-}SiR_d(OR^3)_{3-d} \qquad (3)$$

wherein

R in formula (3) may be identical or different and is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation,,

R^3 is selected from H (hydrogen) and alkyl radicals having 1 to 6 carbon atoms, and may be identical or different,

R^4 is a difunctional optionally substituted hydrocarbyl radical with up to 15 carbon atoms, which may contain one or more heteroatoms selected from O, N and S atoms, and which is bond to the silicon atoms via an Si-C-bond, and

d is 0 to 2.

In another aspect, there is provided a composition as defined above further comprising an adhesion enhancing agent (E).

In another aspect, there is provided a composition as defined above having cohesive failure in the range of 60-100% in the cured state on an aluminium or PBT substrate in a OverLapShear (OLS) Test.

In another aspect, there is provided the use of a curable silicone composition as defined above as a potting compound in the potting of electronic components.

In accordance with one example of the present disclosure there is provided a potting compound comprising a curable silicone composition, the composition comprising:

(A) at least one polyorganosiloxane having at least one, preferably at least two alkenyl group bonded to a silicon atom,

(B) at least one organohydrogensiloxane having at least one SiH group,

(C1) at least one photo-activatable hydrosilylation catalyst,

(C2) at least one non-photo-activatable hydrosilylation catalyst, and

(D) optionally additives,

for potting and encapsulation of electronic components, more specifically in automotive and power applications for the protection against moisture, dust and environmental hazards.

In one example, the composition is provided as a first part and a second part with a first part comprising the at least one organopolysiloxane having at least one alkenyl group, the photo-activatable catalyst, and the non-photo-activatable catalyst and a second part comprising the at least one organohydrogensiloxane. In one example, the compositions are cured by exposing the composition (after application to a desired location, e.g., cavity, mold, chamber, etc.) to UV irradiation to cure the composition in areas accessible to such irradiation, and subsequently exposing the composition to a temperature sufficient to cure the composition in areas that are not accessible to UV irradiation.

In one example, provided are articles comprising the cured compositions.

In one example, provided is a potting compound for use in the potting of electronic equipment, the potting compound comprising a curable silicone composition the composition comprising:

(A) at least one polyorganosiloxane having at least one alkenyl groups bonded to a silicon atom,

(B) at least one organohydrogensiloxane having at least one SiH group,

(C1) at least one photo-activatable hydrosilylation catalyst,

(C2) at least one non-photo-activatable hydrosilylation catalyst, and

(D) optionally additives.

In one example, the electronic components are for automotive or power applications. In one example, the protection of an electronic equipment against moisture, dust, and/or environmental hazards.

In one example in accordance with any of the previous examples, the at least one polyorganosiloxane having at least one alkenyl group A) is selected from the groups of polyorganosiloxanes having the formula (Ia):

$$[M_aD_bT_cQ_dR^9_e]_m \qquad \text{(Ia)}$$

wherein the indices in formula (Ia) are defined as follows:

a = 0 - 10

b = 0 - 2000

c = 0 - 50

d = 0 - 1

e = 0 - 300

m = 1 - 1000

with a, b, c, d and m being such that the viscosity of component (A) at 20 °C is less than 15000 mPa.s(measured at a shear rate of D=10 s^{-1} according to DIN 53019 and for viscosities below 5000 mPa.s measured according to DIN 53015),

and

M is selected from $R_3SiO_{1/2}$ and M*,

D is selected from $R_2SiO_{2/2}$ and D*,

T is selected from $RSiO_{3/2}$ and T*, and

$Q=SiO_{4/2}$,

R^9 is selected from divalent organic groups bound via carbon to two silicon atoms, and

wherein each R, which may be the same or different, is selected from an optionally substituted alkyl group with up to 30 carbon atoms, an optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation, and

wherein $M^*= R^1_pR_{3-p}SiO_{1/2}$, $D^*= R^1_qR_{2-q}SiO_{2/2}$, $T^*= R^1SiO_{3/2}$,

wherein

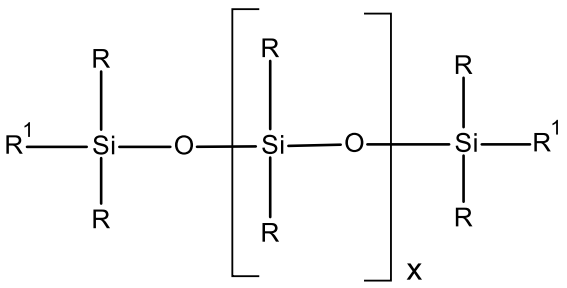
p= 1-3

q= 1-2

R is as defined before, and

R^1 is selected from alkenyl groups.

In one example in accordance with any of the previous examples, the component (A) has the formula (Ia1)



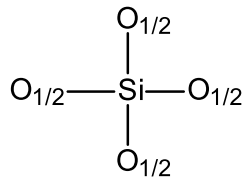
(Ia1),

wherein R^1 and R are as defined above and x is ≥ 0.

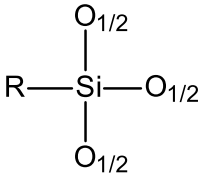
In one example in accordance with any of the previous examples, the component (B) is selected from the group of (B1) a linear SiH-containing polyorganosiloxane and (B2) a branched SiH-containing polyorganosiloxane.

In one example in accordance with any of the previous examples, the component (B) is selected from the group of (B1) a linear polydiorganosiloxane having an SiH group at each end, and (B2) a branched SiH-containing polyorganosiloxane containing at least one M^H unit.

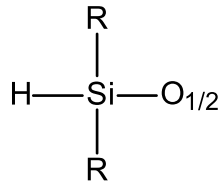
In one example in accordance with any of the previous examples, the branched SiH-containing polyorganosiloxane (B2) are selected from polyorganosiloxanes comprising at least one siloxy unit selected from the group consisting of a Q unit:



and a T unit:

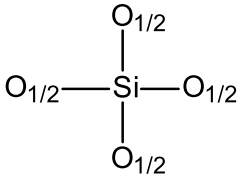


wherein R is as defined above, and at least one siloxy unit M^H:

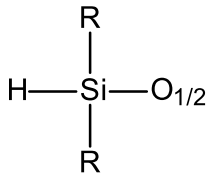


wherein R is alkyl.

In one example in accordance with any of the previous examples, the branched SiH-containing polyorganosiloxane B2) are selected from polyorganosiloxanes consisting of at least one siloxy unit Q:



and at least one siloxy unit M^H:



wherein R is as defined above.

In one example in accordance with any of the previous examples, the SiH-containing polyorganosiloxane resins (B2) are selected from polyorganohydrogensiloxanes consisting of Q and M^H units of the formula

$$\{[Q][M^H]_{0,01\text{-}10}\}_m$$

wherein Q and M^H are as defined above, and m is about 1 to about 20.

In one example in accordance with any of the previous examples, the potting compound comprises a linear polydiorganosiloxane (B1) having an SiH group at each end, and a branched SiH-containing polyorganosiloxane (B2) consisting of Q and M^H units of the formula

$$\{[Q][M^H]_{0,01\text{-}10}\}_m$$

wherein Q, M^H and m are as defined above.

In one example in accordance with any of the previous examples, the organo-metallic hydrosilylation catalyst (C1) or (C2) is selected from the group consisting of transition metal complex catalysts selected from platinum, palladium, rhodium, nickel, iridium, ruthenium, and iron complexes and combinations thereof.

In one example in accordance with any of the previous examples, (C1) is a photo-activatable platinum catalyst selected from the group consisting of η^5-(optionally substituted) cyclopentadienyl platinum(IV) complexes, ß-diketonato trimethylplatinum (IV) complexes, bis(β -diketonato) platinum(II) complexes, bis(phosphine) platinum(II) complexes, cyclooctadiene platinum(II) complexes, and mixtures thereof.

In one example in accordance with any of the previous examples, the non-photoactivatable hydrosilylation catalyst (C2) is platinum catalyst selected from the group consisting of platinum compounds such as chloroplatinic acid, or platinum complexes such as platinum/vinylsiloxane complexes, or mixtures thereof.

In one example in accordance with any of the previous examples, the potting compound comprises he additive (D) selected from of the group consisting of a hydrosilylation reaction inhibitor.

In one example in accordance with any of the previous examples, the potting compound comprises as the additive (D) at least one selected from the group consisting of an optical brightener or UV tracer (fluorescent whitening agent).

In one example in accordance with any of the previous examples, the potting compound comprises:

- 100 parts per weight of at least one polyorganosiloxane (A) having at least one alkenyl group bonded to a silicon atom,
- 0.1 to 30 parts per weight of at least one organohydrogensiloxane (B) having at least one SiH group,
- 0.1 to 3.5 weight per cent of at least one photo-activatable hydrosilylation catalyst (C1) based on total weight of (A) and (B),
- 1 to 1000 ppm at least one non-photo-activatable hydrosilylation catalyst (C2) based on the total weight of the components (A) and (B), and
- 0.1 to 10 parts of optionally additives (D).

In one example in accordance with any of the previous examples, the potting compound comprises:

- 100 parts per weight of at least one polyorganosiloxane (A) having at least one, alkenyl group bonded to a silicon atom,
- 0.1 to 25 parts per weight of at least one linear polyorganosiloxane (B1) having an SiH group at each end,
- 0.1 to 5 parts per weight of at least one polyorganohydrogensiloxane (B2) having at least one siloxy unit Q and at least one siloxy unit M^H as defined above,
- 1 to 1000 ppm of at least one photo-activatable hydrosilylation catalyst (C1) based on total weight of (A) and (B),
- 0.1 to 3.1 weight percent at least one non-photo-activatable hydrosilylation catalyst (C2) based on the total weight of the components (A) and (B), and
- 0.1 to 10 parts (D) optionally additives.

In one example in accordance with any of the previous examples, the said silicone composition has a viscosity below 1000 mPa.s at 20°C measured according to DIN 53015.

In one example in accordance with any of the previous examples,:

(A) is selected from at least one linear polyorganosiloxane having at both ends one alkenyl group bonded to a silicon atom,

(B) is selected from a linear polydiorganosiloxane (B1) having an SiH group at each end, and an SiH-containing polyorganosiloxane resin (B2) consisting of Q and M^H units as defined above,

(C1) at least one photo-activatable hydrosilylation catalyst,

(C2) at least one non-photo-activatable hydrosilylation catalyst, and

In one example in accordance with any of the previous examples, the potting compound comprises at least one adhesion enhancing agent (E).

In one example in accordance with any of the previous examples, the adhesion agent is selected from a titanate compound.

In one example in accordance with any of the previous examples, the adhesion enhancing agent (E) is tetra-n butyltitanate.

In one example in accordance with any of the previous examples, the said silicone composition has a viscosity below 1000 mPa.s at 20°C measured according to DIN 53015.

In another example, provided is a process of curing the curable silicone composition as defined in any of the previous examples to a cured silicone composition in a chamber/cavity of the electronic component having areas not readily accessible to direct UV light irradiation, the process comprising:

a) applying the said curable silicone composition into the chamber/cavity in a manner so as to fill in the chamber/cavity.

b) irradiating the chamber/cavity with UV irradiation sufficient to substantially cure the composition in the areas directly accessible to UV light, and

c) exposing the composition on the chamber/cavity to a temperature of ≥ 20°C for sufficient time to cure the composition in the areas not accessible to UV light.

In still another example, provided is a process of curing of the curable silicone compositions as defined in any of the previous examples to a cured silicone composition for the manufacture of connector potting, the process comprising

a) applying said curable silicone composition to a chamber/cavity/pocket comprising pin connectors,

b) exposing said curable silicone composition to UV light, and

c) then curing in areas not accessible to UV light in a temperature range of 20 to 80°C.

In a further example, provided is a cured composition obtained by the curing of the curable silicone composition according to any of the previous examples by a UV radiation cure step followed by a cure step at a temperature in the range of ≥ 20°C and ≤80°C.

In yet another example, provided is an article prepared by the steps, comprising:

I. mixing, so as to form a curable composition as defined in any of the previous emodiments,

II. applying a potting of/dispensing said curable composition into a chamber/cavity of the electronic component; and

III. curing said curable composition to said chamber/cavity by exposing the said curable composition in the potting chamber/cavity to a source of UV radiation and thereafter non photoactivatable curing said curable composition at a temperature in the range of 20 to 80°C.

In one example, the substrate is a circuit board or pin connector.

In yet a further example, provided is a use of the curable silicone composition, as above in the form of a kit of two parts system.

In another example, provided is a composition comprising:

(a) a first part comprising (A) at least one polyorganosiloxane having at least one alkenyl group bonded to a silicon atom, (C1) at least one photo-activatable hydrosilylation catalyst, and (C2) at least one non-photo-activatable hydrosilylation catalyst, and

(b) a second part comprising (B) at least one organohydrogensiloxane having at least one SiH group, and (D1) a polyorganosiloxane, different from (B) comprising at least one unit selected from the group consisting of

$R(H)SiO_{2/2}$ and

$R^5(R)SiO_{2/2}$,

wherein R is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation, R^5 is selected from the group consisting of unsaturated aliphatic group with up to 14 carbon atoms, epoxy–group-containing aliphatic group with up to 14 carbon atoms, cyanurate–containing group, and an isocyanurate–containing group, and

further comprising at least one unit of the formula (3):

$$- O_{2/2}(R)Si\text{-}R^4\text{-}SiR_d(OR^3)_{3-d} \qquad (3)$$

wherein

R in formula (3) may be identical or different and is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation,,

R^3 is selected from H (hydrogen) and alkyl radicals having 1 to 6 carbon atoms, and may be identical or different,

R^4 is a difunctional optionally substituted hydrocarbyl radical with up to 15 carbon atoms, which may contain one or more heteroatoms selected from O, N and S atoms, and which is bond to the silicon atoms via an Si-C-bond, and

d is 0 to 2.

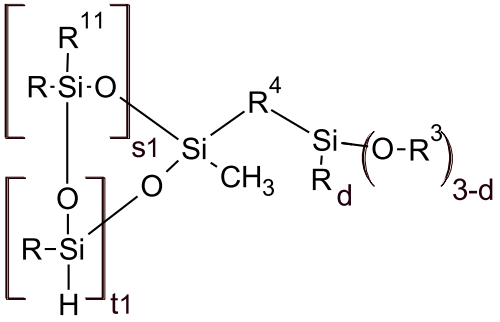
In one example, the polyorganosiloxane (A) is selected from at least one linear polyorganosiloxane having at least one alkenyl group; and the organohydrogensiloxane (B) is selected from at least one linear polydiorganosiloxane (B1) having an SiH group at each end, and at least one SiH-containing polyorganosiloxane resin (B2) consisting of Q and M^H units where Q is $SiO_{4/2}$, and M^H is $HR_2SiO_{1/2}$, where R of the M^H unit may be identical or different and is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms,

and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4) alkyleneoxy groups, the groups R being free of aliphatic unsaturation.

In one example in accordance with any of the previous examples, the composition comprises:

- 100 parts per weight of the at least one polyorganosiloxane (A) having at least one alkenyl group bonded to a silicon atom,
- 0.1 to 25 parts per weight of the at least one linear polyorganosiloxane (B1) having an SiH group at each end,
- 0.1 to 5 parts per weight of the at least one polyorganohydrogensiloxane (B2) having at least one siloxy unit Q and at least one siloxy unit M^H as defined above,
- 1 to 1000 ppm of the at least one photo-activatable hydrosilylation catalyst (C1) based on total weight of (A) and (B),
- 0.1 to 3.1 weight percent at least one non-photo-activatable hydrosilylation catalyst (C2) based on the total weight of the components (A) and (B),
- 0.1 to 10 weight percent of the component (D1) based on the total weight of part (a) and (b), and
- 0.001 to 10 parts per weight of an additive.

In one example in accordance with any of the previous examples, (D1) is selected from a compound of the formula (3a):



(3a)

R^{11} is R or R^5; and R^4 is a difunctional optionally substituted hydrocarbyl radical with up to 15 carbon atoms, which may contain one or more heteroatoms selected from O, N and S atoms, and which is bond to the silicon atoms via an Si-C-bond,

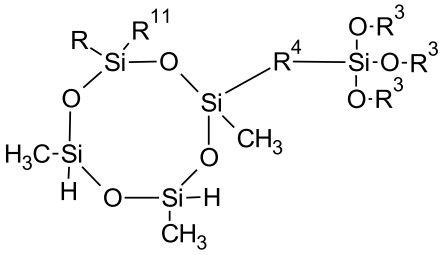
s1 = 0-6

t1 = 0-6

s1 + t1 = 2 – 6

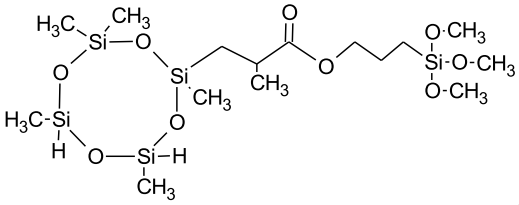
with the proviso that there is at least one group –(OSi(R)H)- or –(OSi(R)(R^{11}))- in the compound.

In one example in accordance with any of the previous examples, the compound of formula (3a) has the formula:



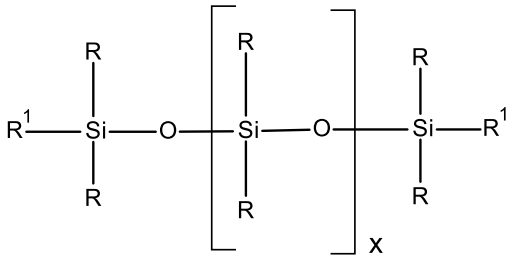
.

In one example in accordance with any of the previous examples, the compound of formula (3a) has the formula:



.

In one example in accordance with any of the previous examples, the polyorganosiloxane (A) is of the formula (Ia1):



(Ia1)

wherein each R is independently selected from a saturated organic group, each R^1 is independently selected from an alkenyl group, and x is ≥ 0.

In one example in accordance with any of the previous examples, the composition, upon combining parts (a) and (b), has a viscosity of from about 50 mPa.s to about 10 Pa.s at 20°C measured at a shear rate of D=10 s^{-1} according to DIN 53019 for viscosities above 5000 mPa.s and measured according to DIN 53015 at 20°C for viscosities below 5000 mPa.s.

In one example in accordance with any of the previous examples, the composition, upon combining parts (a) and (b), has a viscosity of 100 mPa.s to about 1000 mPa.s at 20°C measured according to DIN 53015.

In one example in accordance with any of the previous examples, the composition, upon combining parts (a) and (b), has a viscosity of 200 mPa.s to about 800 mPa.s at 20°C measured according to DIN 53015.

In one example in accordance with any of the previous examples, the composition, upon combining parts (a) and (b), has a viscosity of 300 mPa.s to about 500 mPa.s at 20°C measured according to DIN 53015.

In one example in accordance with any of the previous examples, the silicone composition has a viscosity below 1000 mPa.s at 20°C measured according to DIN 53015.

In one example, provide is a process of curing the curable silicone composition as defined in any of the previous examples in a chamber/cavity of an electronic component having areas not readily accessible to direct UV light irradiation, the process comprising:

(i) combining part (a) and part (b) to form the curable silicone composition;

(ii) applying the curable silicone composition into the chamber/cavity in a manner so as to fill in the chamber/cavity;

(iii) irradiating the chamber/cavity with UV irradiation sufficient to substantially cure the composition in the areas directly accessible to UV light; and

(iv) exposing the composition on the chamber/cavity to a temperature of ≥ 20°C for sufficient time to cure the composition in the areas not accessible to UV light.

In another example, provided is a process of curing the curable silicone compositions as defined in any of the previous examples to a cured silicone composition for the manufacture of connector potting or encapsulation of electronic components, the process comprising

(i) combining part (a) and part (b) to form the curable composition;

(ii) applying said curable silicone composition to a chamber/cavity/pocket comprising pin connectors,

(iii) exposing said curable silicone composition to UV light, and

(iv) curing in areas not accessible to UV light in a temperature range of 20 to 80°C.

In a further example, provided is an article prepared by:

(i) mixing part (a) and part (b), so as to form a curable composition as defined in any of the previous examples,

(ii) applying a potting of/dispensing of said curable composition into a chamber/cavity of the electronic component; and

(iii) curing said curable composition to said chamber/cavity by exposing the said curable composition in potting chamber/cavity to a source of UV radiation and thereafter non-photoactivatable curing said curable composition at a temperature in the range of 20 to 80°C.

In one example, the substrate is a circuit board or a connector plug.

In still another example, provided is a composition comprising:

(A) at least one polyorganosiloxane having at least one, alkenyl groups bonded to a silicon atom,

(B) at least one organohydrogensiloxane having at least one SiH group,

(C1) at least one photo-activatable hydrosilylation catalyst,

(C2) at least one non-photo-activatable hydrosilylation catalyst, and

(D1) A polyorganosiloxane comprising at least one unit selected from the group consisting of

$R(H)SiO_{2/2}$ and

$R^5(R)SiO_{2/2}$,

wherein R is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation, R^5 is selected from the group consisting of unsaturated aliphatic group with up to 14 carbon atoms, epoxy–group-containing aliphatic group with up to 14 carbon atoms, cyanurate–containing group, and an isocyanurate–containing group, and

further comprising at least one unit of the formula (3):

$$-O_{2/2}(R)Si\text{-}R^4\text{-}SiR_d(OR^3)_{3-d} \qquad (3)$$

wherein

R in formula (3) may be identical or different and is selected from optionally substituted alkyl with up to 30 carbon atoms, optionally substituted aryl with up to 30 carbon atoms, and an organic group bound to Si via carbon comprising a poly(C2-4)-alkyleneoxy moiety with up to 1000 (C2-C4)alkyleneoxy groups, the groups R being free of aliphatic unsaturation,,

R^3 is selected from H (hydrogen) and alkyl radicals having 1 to 6 carbon atoms, and may be identical or different,

R^4 is a difunctional optionally substituted hydrocarbyl radical with up to 15 carbon atoms, which may contain one or more heteroatoms selected from O, N and S atoms, and which is bond to the silicon atoms via an Si-C-bond, and

d is 0 to 2.

In one example, the composition comprises an adhesion enhancing agent (E).

In one example in accordance with any of the previous examples, the composition has a lap shear strength of at least 0.1 MPa when interposed between a first substrate that is glass and a second substrate that is either Aluminium or PBT.

In one example in accordance with any of the previous examples, the composition has a cohesive failure in the range of 60-100% in the cured state on a metal or plastic substrate in a OverLapShear (OLS) Test.

In one example in accordance with any of the previous examples, the composition has a cohesive failure in the range of 60-100% in the cured state on an aluminium or PBT substrate in a OverLapShear (OLS) Test.

In a further example, provided is a use of a curable silicone composition of any of the previous examples as a potting compound in the potting of electronic components. In one example, the electronic components are for automotive or power applications.

In one example, the electronic components are for automotive or power applications.

In one example, the use is for the protection against moisture, dust, and/or environmental hazards.

These and other examples and examples are further understood with respect to the following detailed description.

DETAILED DESCRIPTION

Reference will now be made to exemplary embodiments. It is to be understood that other embodiments may be utilized and structural and functional changes may be made. Moreover, features of the various embodiments may be combined or altered. As such, the following description is presented by way of illustration only and should not limit in any way the various alternatives and modifications that may be made to the illustrated embodiments. In this disclosure, numerous specific details provide a thorough understanding of the subject disclosure. It should be understood that aspects of this disclosure may be practiced with other embodiments not necessarily including all aspects described herein, etc.

As used herein, the words "example" and "exemplary" means an instance, or illustration. The words "example" or "exemplary" do not indicate a key or preferred aspect or embodiment. The word "or" is intended to be inclusive rather than exclusive, unless context suggests otherwise. As an example, the phrase "A employs B or C," includes any inclusive permutation (e.g., A employs B; A employs C; or A employs both B and C). As another matter, the articles "a" and "an" are generally intended to mean and may be used interchangeably with the phrases "one or more," "at least one," and the like unless context suggest otherwise. The word "adhesion enhancing agent" means a substance that increases adhesion between two surfaces, typically between the surface of a silicone composition and the surface of a substrate.

Numerical values presented in a range or subsets of ranges can be combined to form new and non-specified ranges.

Provided is a composition that exhibits curing characteristics and can be cured by exposure to high energy conditions (i.e., photo-activatable) as well as by exposure to non-photoactivatable conditions (e.g., condensation curing and/or at elevated temperatures). The present compositions are suitable for use as a potting compound in electronic applications and can be used as a material to fill space in and around electronic components. Also provided are methods of curing and using the compositions in various applications.