Disclosure of Invention

Problem to be Solved by the Invention

[0004] However, the conventional heat conductive sheets have problems in a steady load value and flexibility, and therefore need to be improved further.

Embodiments of the present invention provide a thermally conductive sheet with a high thermal conductivity, a low steady load value, and flexibility and a method for producing the thermally conductive sheet.

Means for Solving Problem

[0005] ~~According to a first aspect of the present invention, there is provided a thermally conductive sheet including: a matrix resin and thermally conductive particles. A content of the thermally conductive particles is 200 parts by volume or more with respect to 100 parts by volume of the matrix resin component. A polymer viscosity of the matrix resin component after a crosslinking reaction in the absence of the thermally conductive particles is 500 Pa·s or less at 25°C. A thermal conductivity of the thermally conductive sheet is 2.0 W/m·K or more. When the thermally conductive sheet with an initial thickness of 1.5 mm is compressed at a compression rate of 5.0 mm/min to measure a 50% compressive load value, a maximum load value is 100 kPa or more and a load value after 1 minute is more than 0 kPa and 100 kPa or less.~~

According to a first aspect of the present invention, there is provided a thermally conductive sheet including: a matrix resin; and thermally conductive particles, wherein the thermally conductive particles are alumina particles, a content of the alumina particles is 200 parts by volume or more with respect to 100 parts by volume of the matrix resin component, the alumina particles with an average particle size of 30 to 100 μm are 50 vol% or more and the alumina particles with an average particle size of less than 30 μm are 50 vol% or less when the total amount of the alumina particles is taken as a parameter, the alumina particles with an average particle size of 30 to 100 μm are spherical in shape, the alumina particles with an average particle size of less than 30 μm are irregular in shape, a polymer viscosity of the matrix resin component after a crosslinking reaction in the absence of the alumina particles is 500 Pa·s or less at 25°C and no unreacted oil is added, a thermal conductivity of the thermally conductive sheet is 2.0 W/m·K or more, and when the thermally conductive sheet with an initial thickness of 1.5 mm is compressed at a compression rate of 5.0 mm/min to measure a 50% compressive load value, a maximum load value is 100 kPa or more and a load value after 1 minute is more than 0 kPa and 100 kPa or less.

[0006] ~~According to a second aspect of the present invention, there is provided a method for producing the above thermally conductive sheet including: forming a compound with the following composition into a sheet, and heat-curing the sheet: (A) 100 parts by volume of a base polymer component that is a linear organopolysiloxane having an average of two or more alkenyl groups per molecule, in which the alkenyl groups are bonded to silicon atoms at both ends of a molecular chain; (B) a crosslinking component that is an organohydrogenpolysiloxane having an average of two or more hydrogen atoms bonded to silicon atoms per molecule, in which the number of moles of the organohydrogenpolysiloxane is less than 3 moles with respect to 1 mole of the alkenyl groups bonded to the silicon atoms in the component A; (C) a catalyst component at a concentration of 0.01 to 1000 ppm based on a weight of metal atoms with respect to the component A; and (D) 200 parts by volume or more of thermally conductive particles with respect to 100 parts by volume of the component A.~~

According to a second aspect of the present invention, there is provided a method for producing the above thermally conductive sheet, including: forming a compound with the following composition into a sheet; and heat-curing the sheet: (A) 100 parts by volume of a base polymer component that is a linear organopolysiloxane having an average of two or more alkenyl groups per molecule, in which the alkenyl groups are bonded to silicon atoms at both ends of a molecular chain; (B) a crosslinking component that is an organohydrogenpolysiloxane having an average of two or more hydrogen atoms bonded to silicon atoms per molecule, in which the number of moles of the organohydrogenpolysiloxane is less than 3 moles with respect to 1 mole of the alkenyl groups bonded to the silicon atoms in the component A; (C) a catalyst component at a concentration of 0.01 to 1000 ppm based on a weight of metal atoms with respect to the component A; and (D) 200 parts by volume or more of thermally conductive alumina particles with respect to 100 parts by volume of the component A, wherein the alumina particles with an average particle size of 30 to 100 μm are 50 vol% or more and the alumina particles with an average particle size of less than 30 μm are 50 vol% or less when the total amount of the alumina particles is taken as a parameter, the alumina particles with an average particle size of 30 to 100 μm are spherical in shape, the alumina particles with an average particle size of less than 30 μm are irregular in shape, and a polymer viscosity of the matrix resin component after a crosslinking reaction in the absence of the alumina particles is 500 Pa·s or less at 25°C and no unreacted oil is added.

Effects of the Invention

[0007] The thermally conductive sheet according to embodiments of the present invention contains 200 parts by volume or more of the thermally conductive particles with respect to 100 parts by volume of the matrix resin component. The polymer viscosity of the matrix resin component after the crosslinking reaction in the absence of the thermally conductive particles is 500 Pa·s or less at 25°C. The thermal conductivity of the thermally conductive sheet is 2.0 W/m·K or more. When the thermally conductive sheet with an initial thickness of 1.5 mm is compressed at a compression rate of 5.0 mm/min to measure a 50% compressive load value, the maximum load value is 100 kPa or more and the load value after 1 minute is more than 0 kPa and 100 kPa or less. Thus, the thermally conductive sheet can have a high thermal conductivity, a low steady load value, and flexibility. The particular feature that the polymer viscosity of the matrix resin component after the crosslinking reaction in the absence of the thermally conductive particles is 500 Pa·s or less at 25°C increases the thermal conductivity, reduces the steady load value, and greatly relaxes the compression of the thermally conductive sheet. Since the thermally conductive sheet is gradually compressed, it can be held with a low load, and thus damage to the holding member is reduced. Because of its low load value and flexibility, the thermally conductive sheet follows the unevenness of electronic components well. Moreover, the thermally conductive sheet has good handleability due to the initial load value.

Brief Description of Drawings

[0008] [FIG. 1] FIG. 1 is a schematically cross-sectional side view of a compressive load measuring device used in an example of the present invention.

[FIG. 2] FIGS. 2A to 2B are diagrams illustrating a method for measuring a thermal conductivity used in an example of the present invention.

Description of the Invention

CLAIMS

~~[1]~~ 1. A thermally conductive sheet comprising:

a matrix resin; and

thermally conductive particles,

wherein the thermally conductive particles are alumina particles,

a content of the ~~thermally conductive~~ alumina particles is 200 parts by volume or more with respect to 100 parts by volume of the matrix resin component,

the alumina particles with an average particle size of 30 to 100 μm are 50 vol% or more and the alumina particles with an average particle size of less than 30 μm are 50 vol% or less when the total amount of the alumina particles is taken as a parameter,

the alumina particles with an average particle size of 30 to 100 μm are spherical in shape,

the alumina particles with an average particle size of less than 30 μm are irregular in shape,

a polymer viscosity of the matrix resin component after a crosslinking reaction in the absence of the ~~thermally conductive~~ alumina particles is 500 Pa·s or less at 25ºC and no unreacted oil is added,

a thermal conductivity of the thermally conductive sheet is 2.0 W/m·K or more, and

when the thermally conductive sheet with an initial thickness of 1.5 mm is compressed at a compression rate of 5.0 mm/min to measure a 50% compressive load value, a maximum load value is 100 kPa or more and a load value after 1 minute is more than 0 kPa and 100 kPa or less.

~~[2]~~ 2. The thermally conductive sheet according to claim 1, wherein the matrix resin component is a silicone polymer.

~~[3]~~ 3. The thermally conductive sheet according to claim 1 or 2, wherein the matrix resin component is an addition curing type silicone polymer.

~~[4]~~ 4. The thermally conductive sheet according to any one of claims 1 to 3, wherein the polymer viscosity of the matrix resin component after the crosslinking reaction in the absence of the ~~thermally conductive~~ alumina particles is 1 to 150 Pa·s.

~~[5]. The thermally conductive sheet according to any one of claims 1 to 4, wherein the thermally conducive particles are composed of at least one selected from the group consisting of metal oxide, metal hydroxide, aluminum~~

~~nitride, boron nitride, and silica.~~

~~[6]. The thermally conductive sheet according to any one of claims 1 to 5, wherein the thermally conductive particles with an average particle size of 30 to 100 μm are 50 vol% or more and the thermally conductive particles with an average particle size of less than 30 μm are 50 vol% or less when the total amount of the thermally conductive particles is taken as a parameter.~~

~~[7]. The thermally conductive sheet according to claim 6, wherein the thermally conductive particles with an average particle size of 30 to 100 μm are spherical in shape.~~

~~[8]. The thermally conductive sheet according to claim 6, wherein the thermally conductive particles with an average particle size of less than 30 μm are irregular in shape.~~

~~[9]~~ 5. The thermally conductive sheet according to any one of claims 1 to ~~8~~ 4, wherein the ~~thermally conductive~~ alumina particles are surface treated with a silane compound, a titanate compound, an aluminate compound, or partial hydrolysates thereof.

~~[10]~~ 6. A method for producing the thermally conductive sheet according to any one of claims 1 to ~~9~~ 5, comprising:

forming a compound with the following composition into a sheet; and

heat-curing the sheet:

(A) 100 parts by volume of a base polymer component that is a linear organopolysiloxane having an average of two or more alkenyl groups per molecule, in which the alkenyl groups are bonded to silicon atoms at both ends of a molecular chain;

(B) a crosslinking component that is an organohydrogenpolysiloxane having an average of two or more hydrogen atoms bonded to silicon atoms per molecule, in which the number of moles of the organohydrogenpolysiloxane is less than 3 moles with respect to 1 mole of the alkenyl groups bonded to the silicon atoms in the component A;

(C) a catalyst component at a concentration of 0.01 to 1000 ppm based on a weight of metal atoms with respect to the component A; and

(D) 200 parts by volume or more of thermally conductive alumina particles with respect to 100 parts by volume of the component A,

wherein the alumina particles with an average particle size of 30 to 100 μm are 50 vol% or more and the alumina particles with an average particle size of less than 30 μm are 50 vol% or less when the total amount of the alumina particles is taken as a parameter.

the alumina particles with an average particle size of 30 to 100 μm are spherical in shape,

the alumina particles with an average particle size of less than 30 μm are irregular in shape, and

a polymer viscosity of the matrix resin component after a crosslinking reaction in the absence of the alumina particles is 500 Pa·s or less at 25°C and no unreacted oil is added.

[11] 7. The method according to claim 10 6, wherein the heat curing conditions of the sheet are that a temperature is 90 to 120°C and a time is 5 to 180 minutes.