# DESCRIPTION

# THERMALLY CONDUCTIVE COMPOSITION AND METHOD FOR PRODUCING THE SAME

## Technical Field

[0001] The present invention relates to a thermally conductive composition with reduced interfacial debonding resulting from stress, and a method for producing the thermally conductive composition.

## Background Art

[0002] With the significant improvement in performance of semiconductors such as CPUs in recent years, the amount of heat generated by them becomes extremely large. For this reason, heat dissipating materials are attached to electronic components that may generate heat, and a thermally conductive sheet is used to improve the adhesion between heat dissipating members and semiconductors. The thermally conductive sheet has been required to have a high thermal conductivity, a low steady load value, and flexibility as recent devices become smaller in size and higher in performance. Patent Document 1 proposes to improve the compressibility, insulation properties, thermal conductive properties, etc. of a thermally conductive silicone composition by setting the viscosity of the composition to 800 Pa·s or less at 23°C before curing. Moreover, thermally conductive compositions containing a silicone resin recently have been proposed as heat dissipating materials for, e.g., hybrid vehicles, electric vehicles, and fuel cell powered vehicles (Patent Documents 2 and 3).

## Prior Art Documents

### Patent Documents

[0003] Patent Document 1: JP 2013-147600 A

Patent Document 2: JP 2014-224189 A

Patent Document 3: JP 2019-009237 A

## Disclosure

### Problem to be Solved

[0004] However, in the conventional thermally conductive compositions, when inorganic particles with a small specific surface area are added to improve the thermal conductive properties, interfacial debonding may occur between the inorganic particles and the polymer due to stress.

To solve the above conventional problems, the present disclosure provides a thermally conductive composition that has high thermal conductive properties, a high compression repulsive force, and less interfacial debonding resulting from stress, and also provides a method for producing the thermally conductive composition.

Means for Solving Problem

[0004a] In an aspect, there is provided a thermally conductive composition comprising:

a base polymer, an adhesive polymer, and thermally conductive particles,

wherein a thermal conductivity of the thermally conductive composition is 0.3 W/m·K or more,

the thermally conductive particles include inorganic particles (a) with a specific surface area of 1 $m^2/g$ or less,

the inorganic particles (a) are coated with the adhesive polymer, and

the adhesive polymer contains a methyl hydrogen polysiloxane, an epoxy group-containing alkyltrialkoxysilane, and a cyclic polysiloxane oligomer.

[0004b] In another aspect, there is provided a method for producing the thermally conductive composition as defined above, comprising:

a first mixing process of mixing the adhesive polymer and the inorganic particles (a) with a specific surface area of 1 $m^2/g$ or less so that the inorganic particles (a) are coated with the adhesive polymer;

a second mixing process of adding and mixing the base polymer; and

a curing process.

[0005] A thermally conductive composition of the present disclosure contains a base polymer, an adhesive polymer, and thermally conductive particles. A thermal conductivity of the thermally conductive composition is 0.3 W/m·K or more. The thermally conductive particles include inorganic particles (a) with a specific surface area of 1 $m^2/g$ or less. The inorganic particles (a) are coated with the adhesive polymer.

[0006] A method for producing a thermally conductive composition of the present disclosure provides the thermally conductive composition as described above. The method includes the following: a first mixing process of mixing an adhesive polymer and inorganic particles (a) with a specific surface area of 1 $m^2/g$ or less so that the inorganic particles (a) are coated with the adhesive polymer; a second mixing process of adding and mixing a base polymer; and a curing process.

Effects of the Disclosure

[0007] The present disclosure requires that the thermally conductive composition have a thermal conductivity of 0.3 W/m·K or more, that the thermally conductive particles include inorganic particles (a) with a specific surface area of 1 $m^2/g$ or less, and that the inorganic particles (a) be coated with the adhesive polymer. With this configuration, the present disclosure can provide the thermally conductive composition that has high thermal conductive properties, a high compression repulsive force, and less interfacial debonding resulting from stress. The present disclosure also can provide a method for producing the thermally conductive composition. The production method of the present disclosure includes a first mixing process of mixing the adhesive polymer and the inorganic particles (a) with a specific surface area of 1 $m^2/g$ or less so

that the inorganic particles (a) are coated with the adhesive polymer, a second mixing process of adding and mixing the base polymer, and a curing process. Thus, the thermally conductive composition of the present disclosure can be produced efficiently and reasonably.

## Brief Description of Drawings

[0008] [FIG. 1] FIGS. 1A to 1B are diagrams illustrating a method for measuring a thermal conductivity used in an example of the present invention.

[FIG. 2] FIG. 2 is a diagram illustrating a method for measuring a tensile lap-shear strength used in an example of the present invention.

[FIG. 3] FIG. 3 is image data by a scanning electron microscope/energy dispersive x-ray spectroscopy (SEM/EDX), showing a fracture surface of a thermally conductive composition sheet in Example 1 of the present invention.

[FIG. 4] FIG. 4 is image data by a scanning electron microscope/energy dispersive x-ray spectroscopy (SEM/EDX), showing a fracture surface of a thermally conductive composition sheet in Comparative Example 1.

## Description of the Invention

[0009] It is generally known that the effect of improving the interface between inorganic particles and a polymer cannot easily be achieved by a surface treatment process using, e.g., a silane coupling agent or by integral blending when the inorganic particles have a small specific surface area (such as large-size inorganic particles).

Therefore, debonding is likely to occur at the interface between the inorganic particles and the polymer, and there is a problem of cracks that would result from the debonding due to stress.

To deal with the problem, the present inventors added an adhesive polymer, first mixed the adhesive polymer and inorganic particles (a) with a specific surface area of 1 $m^2/g$ or less, and then mixed inorganic particles (b) with a specific surface area of more than 1 $m^2/g$ and a base polymer. Consequently, the present inventors found that this was effective in reducing cracks. The present invention has been completed based on such an idea.

In this specification, the inorganic particles of 1 $m^2/g$ or less are referred to as inorganic particles (a) and the inorganic particles of more than 1 $m^2/g$ are referred to as inorganic particles (b).