PATENT COOPERATION TREATY

TRANSLATION

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	14.11.2017
Applicant's or agent's file reference: S-343	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/JP2017/035119	28.09.2017	28.09.2016

International Patent Classification (IPC) or both national classification and IPC

C08J5/18(2006.01)i, C08K7/06(2006.01)i, C08L101/00(2006.01)i, H05K7/20(2006.01)i

Applicant

TEIJIN LIMITED

1. This opinion contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☐ Box No. VII — Certain defects in the international application
- ☐ Box No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/JP	Date of completion of this opinion	Authorized officer
Facsimile No.		Telephone No.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/JP2017/035119

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____ , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file.

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/JP2017/035119

Box No. V **Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	4-9, 11	YES
	Claims	1-3, 10, 12, 13	NO
Inventive step (IS)	Claims	11	YES
	Claims	1-10, 12, 13	NO
Industrial applicability (IA)	Claims	1-13	YES
	Claims		NO

2. Citations and explanations:

Document 1: JP 2008-303324 A (BANDO CHEMICAL INDUSTRIES, LTD.) 18 December 2008, entire document, in particular, claims, paragraphs [0014]-[0025], [0031]-[0039], [0050]-[0060], fig. 1-3 (Family: none)

Document 2: JP 2011-165792 A (TEIJIN DUPONT FILMS JAPAN LTD.) 25 August 2011, entire document, in particular, claims, paragraphs [0014]-[0025], [0038]-[0049], [0066]-[0081], [0091]-[0100] (Family: none)

Document 3: JP 2013-038179 A (TEIJIN DUPONT FILMS JAPAN LTD.) 21 February 2013, entire document, in particular, claims, paragraphs [0010], [0018]-[0034], [0045]-[0065] (Family: none)

Document 4: JP 2012-122082 A (SHOWA DENKO KABUSHIKI KAISHA) 28 June 2012, entire document, in particular, claims, paragraphs [0013], [0021]-[0055], [0070], [0071] & JP 2006-321968 A & WO 2006/057458 A1 & TW 200634073 A

Document 5: JP 2012-171986 A (TEIJIN LTD.) 10 September

Box No. V **Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

2012, entire document (Family: none)

Document 6: JP 2005-150362 A (DAINIPPON PRINTING CO., LTD.) 09 June 2005, entire document (Family: none)

Document 7: WO 2016/129257 A1 (NIPPON ZEON CO., LTD.) 18 August 2016, entire document & TW 201631117 A

Document 8: JP 2006-335958 A (POLYMATECH CO., LTD.) 14 December 2006, entire document (Family: none)

The invention as in claims 1, 2 and 12 lacks novelty and does not involve an inventive step in the light of document 1.

Document 1 discloses a rubber molded article obtained from a rubber composition which contains a rubber component (corresponding to the "polymer" in the present invention), vapor-grown carbon fibers and an oil component, and in which the content of the vapor-grown carbon fibers is 20 vol.% or more of the rubber composition and the content of the oil component is 1.5 times or more the content of the vapor-grown carbon fibers on a volume basis, wherein the vapor-grown carbon fibers are aligned in the rubber molded article at a degree of alignment of 80% or more (see claims 1, 3 and 4), and indicates that "in cases where the rubber molded article 1 is a sheet-like rubber sheet, the thickness 4 of the sheet is preferably 0.1-1.0 mm, and more preferably 0.3-0.8 mm (see fig. 1)" (see paragraph [0033]).

In addition, document 1 indicates that "use of fibers having an average diameter of 50-300 nm (which

Box No. V **Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

overlaps that in the present invention within the range "200-300 nm") is preferred as the vapor-grown carbon fibers … the (average) aspect ratio is preferably 10-150 (which overlaps that in the present invention within the range "30-150") (see paragraph [0020]), and if calculated from the diameter and aspect ratio mentioned above, the fiber length is considered to be 0.5-45 μm (which overlaps that in the present invention within the range "5-45 μm").

Furthermore, document 1 indicates that "in the rubber composition of the present invention, the content of the vapor-grown carbon fibers is 20 vol.% or more in (100 vol.% of) the rubber composition, … the content of the vapor-grown carbon fibers is preferably 20-50 vol.%, and more preferably 25-35 vol.%" (see paragraph [0025]), and in view of the specific gravity of the rubber or the like and the difference in specific gravity between the rubber and the carbon fibers, it is considered that the content of the vapor-grown carbon fibers falls within the range specified in the present invention.

In addition, the invention as in claim 2 of the present application specifies "the degree of alignment of carbon fibers, as determined by X-Ray diffraction", whereas the invention of document 1 tentatively differs in that "the degree of alignment of the vapor-grown carbon fibers in the heat radiating sheet is measured by cutting the heat radiating sheet, observing the cut surface with an electron microscope, and performing image processing" (see paragraph [0058]), but because it is considered that the degree of alignment of fibers is measured in both of these inventions, this tentative difference is not a substantial difference.

Box No. V **Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Therefore, there is no substantial difference between the invention as in claims 1, 2 and 12 and the invention disclosed in document 1.

The invention as in claim 3 does not involve an inventive step in the light of document 1.

The present invention specifies that "the thermal conductivity P in a direction which is parallel to the surface of the heat dissipation sheet and which is the direction having the highest degree of alignment is 2-200 times the thermal conductivity T in the thickness direction of the heat dissipation sheet", whereas the invention of document 1 does not specify such a matter.

With regard to this difference, document 1 indicates that "by producing a rubber molded article from a rubber composition containing 20 vol.% or more of vapor-grown carbon fibers and aligning the vapor-grown carbon fibers in a fixed direction inside the molded article, it is possible to achieve high thermal conductivity in this direction of alignment" (see paragraph [0025]).

Therefore, it is considered that investigating directions for increasing thermal conductivity in the invention of document 1 is merely expression of the ordinary creative ability of a person skilled in the art, and constituting in the manner of the present invention is a design matter that could be achieved as appropriate.

The invention as in claims 4-6 does not involve an inventive step in the light of document 1.

The present invention specifies the specifications and blending quantity of a filler and specifies that "the maximum value of the thermal conductivity in the in-plane direction of the sheet is 1.5-50 times the thermal

conductivity in the thickness direction of the sheet", whereas the invention of document 1 does not specify such matters.

With regard to this difference, document 1 indicates that "the heat radiating sheet 11 of the present invention may be one that contains a highly thermally conductive filler. The highly thermally conductive filler can be, for example, … oxide particles such as aluminum hydroxide, aluminum oxide, silicon dioxide, titanium dioxide, mica, potassium titanate, iron oxide or talc, nitride particles such as boron nitride, silicon nitride or aluminum nitride, carbide particles such as silicon carbide, or metal particles such as copper or aluminum" (see paragraph [0039]).

Therefore, a person skilled in the art could easily conceive of investigating the specifications and blending quantity of a highly thermally conductive filler used in the invention of document 1, and because document 1 in no way discloses using nanoparticles as the highly thermally conductive filler, it is not found that constituting in the manner of the present invention would be particularly difficult.

In addition, even in view of disclosures in the description of the present application, it is not considered that the present invention, by means of this difference, achieves a prominent effect that a person skilled in the art could not foresee.

The invention as in claims 7 and 8 does not involve an inventive step in the light of document 1.

Document 1 discloses a heat radiating sheet in which vapor-grown carbon fibers are aligned in a direction that

is approximately perpendicular to the sheet surface of the heat radiating sheet (see claim 5), and discloses a production method that includes "a step (II) for obtaining a rubber sheet in which vapor-grown of carbon fibers are aligned in the sheet surface direction, a step (III) for obtaining a rubber layered body by layering the rubber sheet obtained in step (II), and a step (IV) for cutting the rubber layered body obtained in step (III) in a direction that is approximately perpendicular to the sheet surface of the rubber sheet in the layered body" (see claim 6).

In addition, the present invention specifies that "the thermal conductivity in the thickness direction of the sheet is 1.0-100 times the maximum value of the thermal conductivity in the in-plane direction of the sheet", whereas the invention of document 1 does not specify such a matter.

However, it is considered that investigating directions for increasing thermal conductivity and adjusting thermal conductivity by using a highly thermally conductive filler, as considered in claims 3 and 6, is merely expression of the ordinary creative ability of a person skilled in the art, and it is not found that constituting in the manner of the present invention would be particularly difficult.

The invention as in claims 1, 3, 12 and 13 lacks novelty and does not involve an inventive step in the light of document 2.

Document 2 discloses a biaxially oriented heat dissipating film having a heat conductive layer and an electrically insulating layer on at least one surface of

the heat conductive layer, wherein the heat conductive layer contains 39 mass% of a fibrous carbon material having an average fiber diameter of 0.05-20 μm and an average aspect ratio of 15 or more and contains 1-40 mass% of a heat conductive filler.

Furthermore, document 2 indicates that "the thickness of the heat conductive layer preferably has a lower limit of … 10 μm or more and … an upper limit of preferably less than 500 μm, more preferably less than 300 μm, and particularly preferably less than 200 μm" (see paragraph [0015]), indicates that "the fibrous carbon material in the present invention can be … graphitized carbon short fibers or carbon nanofibers described below (for example, vapor-grown carbon fibers), … the average fiber diameter is 0.05-20 μm, with short fibers being preferred from perspectives such as heat conductivity, dispersibility and fluidity, and the average fiber length is … more preferably 10-1000 μm, and most preferably 50-500 μm" (see paragraphs [0016]-[0019]), and indicates that "the vapor-grown carbon fibers in the present invention preferably have an average fiber diameter of 50-500 nm … and preferably have an average aspect ratio of 20-1000" (see paragraph [0040]).

In addition, document 2 indicates that "in cases where the heat conductive filler described below is not used, a preferred embodiment for achieving superior heat dissipating properties is one in which the content of the fibrous carbon material is preferably 11 mass% or more, more preferably 15 mass% or more, and particularly preferably 20 mass% or more, based on the mass of the

heat conductive layer. In addition, in cases where the heat conductive filler described below is used, the content of the fibrous carbon material should preferably be 1 mass% or more, more preferably 3 mass% or more, and further preferably 5 mass% or more" (see paragraph [0023]), indicates that "the heat conductive filler can be an electrically insulating and heat conductive filler, such as aluminum oxide, silicon oxide, boron nitrite, aluminum nitride or another ceramic material" (see paragraph [0045]), and indicates that "preferred examples of resins able to be used as a matrix material of the heat conductive layer in the present invention include … thermoplastic resins and/or thermoplastic elastomers, … it is possible to use an aliphatic polyamide, a copolymer thereof, an aromatic polyamide or a copolymer thereof, … it is possible to use a fluororesin or a copolymer thereof (poly(vinylidene fluoride), polytetrafluoroethylene, or the like)" (see paragraphs [0046]-[0047]).

Furthermore, example 9 discloses an embodiment in which vapor-grown carbon fibers and aluminum oxide are used, and it is considered that the maximum value of the thermal conductivity in the in-plane direction of the sheet is 5.1 times the thermal conductivity in the thickness direction of the sheet.

Therefore, there is no substantial difference between the invention as in claims 1, 3, 12 and 13 and the invention disclosed in document 2.

In addition, even if there were a difference due to there being no example that satisfies matters specified in claims of the present application, a person skilled in

the art could easily conceive of obtaining the constitution of the present invention on the basis of disclosures in document 2.

The invention as in claim 2 does not involve an inventive step in the light of document 2.

Document 2 indicates that "… by using such stretching conditions, it is possible to appropriately align the film and the fibrous carbon material while suppressing the occurrence of voids in the film and further enhancing the heat dissipation improvement effect" (see paragraph [0074]), and constituting in the manner of the present invention is a design matter that could be addressed as appropriate.

The invention as in claims 4-6 does not involve an inventive step in the light of document 2.

A person skilled in the art could easily conceive of investigating the specifications and blending quantity of the heat conductive filler in the invention of document 2, and because example 9 discloses "spherical alumina particles (Alumina Beads CB-A05S available from Showa Denko Kabushiki Kaisha, average particle diameter 3 μm, density 3.98 g/cc, average aspect ratio 1)", it is not found that constituting in the manner of the present invention would be particularly difficult.

In addition, the invention disclosed in document 2 has the thermal conductivity relationship already specified in claims 3 and 6 of the present application, and even in view of disclosures in the description of the present application, it is not considered that the present invention, by means of this difference, achieves

a prominent effect that a person skilled in the art could not foresee.

The invention as in claims 1, 3 and 12 lacks novelty and does not involve an inventive step in the light of document 3.

Document 3 discloses a biaxially stretched polyester film having high thermal conductivity, which contains a fibrous carbon material having an average fiber diameter of 0.05-1 μm and an average aspect ratio of 100 or more at a quantity of 2-20 wt% relative to the weight of the film, and which has a thermal conductivity in the film surface direction of 2 W/(m·K) or more, indicates that "the fibrous carbon material has an average fiber diameter of 0.05-1 μm … an average aspect ratio of more preferably 110 or more and … preferably 10,000 or less … has an average fiber length of particularly preferably 5-200 μm … the upper limit of the content of the fibrous, material is preferably 15 wt% or less …the average fiber diameter of the carbon nanofibers is preferably 0.1-0.9 μm, and vapor-grown carbon fibers can be given as an example" (see paragraphs [0019]-[0027]), and indicates that "the thickness of the biaxially stretched polyester film is preferably 5-150 μm" (see paragraphs [0034]).

In addition, the examples disclose an embodiment that satisfies the thermal conductivity relationship specified in claim 3 of the present application.

Therefore, there is no substantial difference between the invention as in claims 1, 3 and 12 and the invention disclosed in document 3.

In addition, even if there were a difference due to

there being no example that satisfies matters specified in claims of the present application, a person skilled in the art could easily conceive of obtaining the constitution of the present invention on the basis of disclosures in document 3.

The invention as in claim 2 does not involve an inventive step in the light of document 3.

Document 3 indicates that "… by making the average aspect ratio of the fibrous carbon material 100 or more and increasing the degree of alignment of the film, the carbon material is aligned to a high degree, meaning that it is possible to increase thermal conductivity in at least the film surface direction without adding an excess of the fibrous carbon material" (see paragraph [0024]).

In addition, investigating the degree of alignment and constituting in the matter of the present invention is a design matter that could be addressed, as appropriate, by a person skilled in the art.

The invention as in claim 9 does not involve an inventive step in the light of document 3.

Document 3 indicates that "carbon nanotubes, carbon nanofibers, and the like, are preferred as fibrous carbon materials having the average fiber diameter and average aspect ratio set forth in the present invention. Carbon nanotubes are an allotrope of carbon, are such that a plurality of carbon atoms are bonded together and are aligned in the form of a cylinder, and preferably have an average fiber diameter of 0.1 μm or less" (see paragraph [0025]), and a person skilled in the art could easily conceive of additionally using carbon nanotubes.

In addition, because the invention of document 3 is such that "the average fiber diameter is 0.05-1 μm", it is not found that using carbon nanotubes having an average fiber diameter of 0.4-50 nm would be particularly difficult.

The invention as in claims 1 and 10 lacks novelty and does not involve an inventive step in the light of document 4.

Document 4 discloses a composition for a composite material, which contains ceramic particles and vapor grown carbon fibers having an average fiber diameter of 50-500 nm and an aspect ratio of 5-1000 or carbon nanotubes having an average fiber diameter of 3-50 nm, wherein the vapor grown carbon fibers or carbon nanotubes adhere to at least a part of the surface of the ceramic particles via a polymer compound that exhibits adhesive properties to the vapor grown carbon fibers or carbon nanotubes and to the ceramic particles, and indicates that "the problem to be addressed by the present invention is to provide a molded product used for a heat radiation fan or heat radiation sheet which is light in weight and has high thermal conductivity; and a material for this molded product" (see paragraph [0013]).

In addition, document 4 indicates that "the carbon material may be at least one species selected from the group consisting of carbon fibers, such as vapor grown carbon fibers (thermal conductivity: 400-1200 w/(m·K)), carbon nanotubes (thermal conductivity: 400-1200 w/(m·K)) and pitch-based or PAN-based carbon fibers (thermal conductivity 200-1000 w/(m·K)); coke powder (thermal conductivity: 100-200 w/(m·K)); and graphite powder

(thermal conductivity: 100-200 w/(m·K))" (see paragraph [0021]).

In addition, the examples disclose embodiments in which the vapor grown carbon fibers are contained at a quantity of 4-24 g relative to 100 g of a resin.

Therefore, there is no substantial difference between the invention as in claims 1 and 10 and the invention disclosed in document 4.

In addition, even if there were a difference due to there being no example that satisfies matters specified in claims of the present application, a person skilled in the art could easily conceive of obtaining the constitution of the present invention on the basis of disclosures in document 4.

The invention as in claim 12 does not involve an inventive step in the light of document 4.

The present invention specifies that "the thickness is 0.01-1 mm", whereas the invention of document 4 does not specify such a matter.

However, the invention of document 4 supposes "a molded product used for a heat radiation sheet", and it is considered that investigating the thickness of a heat radiation sheet is merely expression of the ordinary creative ability of a person skilled in the art.

In addition, it is not found that obtaining a heat radiation sheet having a thickness within the range specified in the present invention would be particularly difficult.

The invention as in claim 11 is not disclosed in any

Box No. V **Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

of the documents cited in the ISR and would not be obvious to a person skilled in the art, and therefore is novel and involves an inventive step.

In particular, the documents do not indicate or suggest that "the fibrous carbon has an average effective fiber length of 5-120 μm, an average fiber diameter of 200-900 nm, and an average aspect ratio of 30-10,000" or that "the fibrous carbon has a thickness (Lc) of a net plane group of 1-200 nm and a crystallite length (La) of 20-500 nm, as measured by X-Ray diffraction", but by having such a constitution, the present invention achieves the advantageous effect of "being able to form an extremely thin sheet and achieving higher thermal conductivity than conventional products".