

USE OF TETRAFLUOROETHYLENE OLIGOMER AS REFRIGERANT IN SEMICONDUCTOR MANUFACTURING PROCESS AND ENERGY STORAGE

TECHNICAL FIELD

The present invention specifically relates to use of a tetrafluoroethylene oligomer as a refrigerant in a semiconductor manufacturing process and energy storage.

BACKGROUND

Semiconductor manufacturing process refers to the process of processing semiconductor materials into electronic devices. The semiconductor materials are a kind of materials between conductors and insulators, and have excellent electron conduction performance and electron isolation performance. The semiconductor manufacturing process is one of core technologies of the semiconductor industry, and its importance is self-evident.

The semiconductor manufacturing process mainly includes semiconductor wafer etching, semiconductor chip processing, and semiconductor device processing. Throughout the semiconductor manufacturing process, temperature variations of the manufacturing process are great. Especially at a semiconductor wafer etching stage, a semiconductor wafer has a higher temperature at the etching stage and needs to be cooled. Different manufacturing process units have different treatment temperatures. When a refrigerant has a too high boiling point, although a sufficient cooling effect can be provided, environmental destruction is caused. When a refrigerant has a too low boiling point, a sufficient cooling effect cannot be provided.

CN113773176A proposes a fluorine-containing compound. On the one hand, the fluorine-containing compound is compounded with a fluorine-containing oxaalkane with a chain length of 12 (trioxadodecane grafted with a perfluoroalkyl group and containing at least one hydrogen atom) to increase its boiling range span, and on the other hand, the fluorine-containing compound is compounded with a fluorine-containing alkane with a chain length of 10 (trioxadecane grafted with a perfluoroalkyl group and containing at least one hydrogen atom) to reduce its freezing point, enabling the fluorine-containing compound to be used as a refrigerant in the semiconductor manufacturing process, ensuring that the refrigerant maintains good fluidity during cooling, and improving cooling efficiency of the refrigerant. However, its preparation process is complicated and not easy to promote.

With the increase in energy demands and the popularization of renewable energy, the energy storage industry is in an explosive period against the background of global carbon neutrality, and thermal management of energy storage has become the core of energy storage systems. Cooling methods for the thermal management of energy storage mainly include the following three technical routes: wind cooling (air cooling), liquid cooling, and phase change cooling. Currently, domestic thermal management routes of the energy storage systems basically adopt a forced air cooling method, while liquid cooling for heat dissipation has already been used abroad. The core difference between the air cooling and the liquid cooling lies in different heat transfer media. Specifically, the heat transfer efficiency of liquid media is the highest, which can reach 0.5-10, while the heat transfer efficiency of air media is generally about a few tenths. In terms of heat transfer coefficient, the air media are lower (25-100), while the liquid media are higher (1,000-15,000). Cooling structures involved in the air cooling are simple, convenient to install, and lower in cost, but have low cooling effects, cannot achieve precise temperature control, and require heat dissipation channels with a large area. The liquid cooling achieves convective heat exchange with coolants, thus having more efficient and uniform heat dissipation and better reliability. In the future, with increasing demands for energy storage power stations with larger battery capacity and higher system power density, such as new energy power stations and off-grid energy storage, the energy storage systems will have higher energy density and heat generation capacity, leading to higher requirements for safety and service life, and promoting the industry to adopt more liquid cooling solutions.

Immersion liquid cooling is realized by immersing the energy storage systems in special insulating coolants, and due to direct contact between heat-generating energy storage elements and refrigerants, it has higher heat dissipation efficiency and lower noise, thus becoming one of important technologies in the field of energy storage in the future and having an extremely broad application prospect. However, although the refrigerants currently used in the immersion liquid cooling technology have good cooling effects, their material compatibility and miscibility are poor. During long-term use, materials such as rubber in the energy storage systems may undergo a swelling phenomenon, and the materials may even be damaged.

Therefore, there is an urgent need in the art to develop a refrigerant with a boiling point and fluidity suitable for use in the semiconductor manufacturing process and energy storage, and to enable the refrigerant to be safe and durable and have stable

temperature control and high material compatibility and miscibility during use.

SUMMARY

To address the deficiencies of the prior art, the present invention provides use of a tetrafluoroethylene oligomer as a refrigerant in a semiconductor manufacturing process and energy storage. The tetrafluoroethylene oligomer refrigerant has a suitable boiling point and fluidity, is safe and durable, and has stable temperature control and high material compatibility and miscibility, making it particularly suitable for use as the refrigerant in the semiconductor manufacturing process and energy storage.

To achieve the above purpose, the present invention provides use of a tetrafluoroethylene oligomer as a refrigerant in a semiconductor manufacturing process and energy storage. The tetrafluoroethylene oligomer includes a tetrafluoroethylene pentamer, a tetrafluoroethylene tetramer, and a tetrafluoroethylene hexamer; and based on 100 parts by weight of the tetrafluoroethylene oligomer, the content of the tetrafluoroethylene pentamer is higher than 85 parts by weight, and a weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is lower than 1.

The tetrafluoroethylene oligomer refrigerant of the present invention has a suitable boiling point and fluidity, is safe and durable, and has stable temperature control and high material compatibility and miscibility, making it particularly suitable for use as the refrigerant in the semiconductor manufacturing process and energy storage.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a comparative diagram of the temperature stability of Example 3 and Comparative Examples 1-4 at 40°C.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Endpoints and any values of ranges disclosed herein are not limited to the precise ranges or values, and these ranges or values should be understood to include values that are close to these ranges or values. For numerical ranges, endpoint values of each range, endpoint values of each range and individual point values, and individual point values may be combined with each other to obtain one or more new numerical ranges, and these numerical ranges shall be considered as specifically disclosed herein.

The following provides a detailed description of specific embodiments of the present invention. However, it should be noted that the scope of protection of the present invention is not limited to these specific embodiments, but is determined by the

appended claims.

All publications, patent applications, patents, and other reference documents mentioned in the specification are hereby incorporated by reference. Unless otherwise defined, all technical and scientific terms used in the specification have the meanings commonly understood by those skilled in the art. In a case of a contradiction, definitions in the specification shall prevail.

When the specification refers to materials, substances, methods, steps, devices, or components by the terms "well known to those skilled in the art", "prior art", or similar expressions, objects to which the terms refer include those commonly used in the art at the time when the present invention is proposed, and also include those that have not yet been commonly used but destined to become recognized as suitable for similar purposes in the art.

It should be particularly noted that any two or more aspects (or embodiments) disclosed in the context of the specification may be arbitrarily combined, and technical solutions (such as methods or systems) thus formed are a part of original public contents of the specification and also fall within the scope of protection of the present invention.

In a case of not having an explicit indication, all percentages, parts, ratios, and the like mentioned in the specification are based on weight, except that the weight base is inconsistent with the conventional understanding of those skilled in the art.

The present invention provides use of a tetrafluoroethylene oligomer as a refrigerant in a semiconductor manufacturing process and energy storage. The tetrafluoroethylene oligomer includes a tetrafluoroethylene pentamer, a tetrafluoroethylene tetramer, and a tetrafluoroethylene hexamer; and based on 100 parts by weight of the tetrafluoroethylene oligomer, the content of the tetrafluoroethylene pentamer is higher than 85 parts by weight, and a weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is lower than 1.

Based on specific requirements for the refrigerant in the semiconductor manufacturing process and energy storage, the tetrafluoroethylene pentamer is used as a main component in the present invention, and its high fluidity ensures that the fluidity is more in line with a semiconductor preparation process during use. To improve the applicable temperature range of the refrigerant, the tetrafluoroethylene tetramer and the tetrafluoroethylene hexamer are supplemented. By controlling the weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer, the refrigerant achieves a suitable boiling point, viscosity, and fluidity within the applicable temperature range

of -20°C to 80°C, making it particularly suitable for use as the refrigerant in the semiconductor manufacturing process and energy storage.

In some embodiments, the content of the tetrafluoroethylene tetramer in the tetrafluoroethylene oligomer is more than 0.5 part by weight. Preferably, in some embodiments, the content of the tetrafluoroethylene tetramer in the tetrafluoroethylene oligomer is more than 0.75 part by weight. Further, in some embodiments, the content of the tetrafluoroethylene tetramer in the tetrafluoroethylene oligomer is 1-6 parts by weight. The tetrafluoroethylene tetramer has lower viscosity, and when its content is ensured, the overall oligomer has more suitable viscosity and fluidity during use at a lower temperature.

In some embodiments, the content of the tetrafluoroethylene hexamer in the tetrafluoroethylene oligomer is more than 2 parts by weight. Preferably, in some embodiments, the content of the tetrafluoroethylene hexamer in the tetrafluoroethylene oligomer is more than 3 parts by weight.

In the present invention, any tetrafluoroethylene oligomer meeting the above requirements can achieve the purpose of the present invention. According to one preferred embodiment of the present invention, the content of the tetrafluoroethylene pentamer is 90-97 parts by weight, more preferably 95-97 parts by weight.

In some embodiments, based on 100 parts by weight of the tetrafluoroethylene oligomer, the tetrafluoroethylene oligomer includes 87-97 parts of the tetrafluoroethylene pentamer, 0.5-7.5 parts of the tetrafluoroethylene tetramer, and 2-14.5 parts of the tetrafluoroethylene hexamer.

In some embodiments, based on 100 parts by weight of the tetrafluoroethylene oligomer, the tetrafluoroethylene oligomer includes 87-97 parts of the tetrafluoroethylene pentamer, 0.5-6 parts of the tetrafluoroethylene tetramer, and 2.5-14 parts of the tetrafluoroethylene hexamer.

In some embodiments, based on 100 parts by weight of the tetrafluoroethylene oligomer, the tetrafluoroethylene oligomer includes 87-97 parts of the tetrafluoroethylene pentamer, 1-6 parts of the tetrafluoroethylene tetramer, and 4-9 parts of the tetrafluoroethylene hexamer.

According to one preferred embodiment of the present invention, the weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is 0.05-0.9, further preferably 0.05-0.65. According to one preferred embodiment of the present invention, the weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene

hexamer is 0.1-1/3.

According to one preferred embodiment of the present invention, the weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is 0.1-0.3. The weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is relatively low, enabling the oligomer to play roles well under low-temperature working conditions (such as -20°C).

In the present invention, the boiling point of the tetrafluoroethylene oligomer has a relatively wide selectable range. The following provides an exemplary description, but is not intended to limit the scope of the present invention. According to one preferred embodiment of the present invention, the boiling point of the tetrafluoroethylene oligomer is 100-200°C, preferably 125-145°C. The boiling point in the present invention refers to the temperature at which 5% of the compound is initially distilled.

In the present invention, the kinematic viscosity refers to flowability of the refrigerant used in heat dissipation equipment at different temperatures, and the parameter affects a heat dissipation effect and an operating temperature of the equipment, thus having great significance for heat dissipation and temperature control of the equipment. The kinematic viscosity of the tetrafluoroethylene oligomer at 25°C has a relatively wide selectable range. The following provides an exemplary description, but is not intended to limit the scope of the present invention. According to one preferred embodiment of the present invention, the kinematic viscosity of the tetrafluoroethylene oligomer at 25°C is less than 2 mm²/s, more preferably less than 1.5 mm²/s.

In the present invention, there are no special requirements for the scope of the semiconductor manufacturing process. The following provides an exemplary description, but is not intended to limit the scope of the present invention. According to one preferred embodiment of the present invention, the semiconductor manufacturing process includes semiconductor wafer etching, semiconductor chip processing, and semiconductor device processing.

In the present invention, a condition of the semiconductor manufacturing process has a relatively wide selectable range. The following provides an exemplary description, but is not intended to limit the scope of the present invention. According to one preferred embodiment of the present invention, the condition of the semiconductor manufacturing process includes a temperature of -20°C to 80°C.

In the present invention, there are no special requirements for a specific application

method of the tetrafluoroethylene oligomer as the refrigerant in the semiconductor manufacturing process. For example, in Application Example 1 of the present invention, dual-channel MPX-45FG simulation test equipment is used to simulate the semiconductor manufacturing process, the tetrafluoroethylene oligomer refrigerant is loaded into a chiller of the MPX-45FG simulation test equipment, and a dual-loop PID control algorithm technology is used to test a temperature control effect of the tetrafluoroethylene oligomer refrigerant during the simulation of the semiconductor manufacturing process. The above provides an exemplary description, but is not intended to limit the scope of the present invention.

In the present invention, the use of the tetrafluoroethylene oligomer as the refrigerant in the energy storage has a relatively wide selectable range. All heat-generating energy storage elements can be in direct contact with the refrigerant for heat dissipation, such as chargers, electrolytic capacitors, inductors, energy storage batteries, and energy storage boxes, etc. In Application Example 2 of the present invention, the use as the refrigerant in the energy storage is exemplified by an energy storage battery and an energy storage box to illustrate the advantages of the present invention, but the scope of the present invention is not limited thereto.

The tetrafluoroethylene oligomer refrigerant of the present invention has a suitable boiling point and fluidity, is safe and durable, and has stable temperature control and high material compatibility and miscibility, making it particularly suitable for use as the refrigerant in the semiconductor manufacturing process and energy storage.

The present invention is described in detail below through examples, test example, and application examples. A preparation process of the refrigerant includes mixing corresponding raw materials to obtain the refrigerant.

Example 1

A refrigerant includes, in percentage by weight, the following components:

- 90 wt% of a tetrafluoroethylene pentamer;
- 1 wt% of a tetrafluoroethylene tetramer; and
- 9 wt% of a tetrafluoroethylene hexamer.

Example 2

A refrigerant includes, in percentage by weight, the following components:

- 92 wt% of a tetrafluoroethylene pentamer;
- 2 wt% of a tetrafluoroethylene tetramer; and
- 6 wt% of a tetrafluoroethylene hexamer.

Example 3

A refrigerant includes, in percentage by weight, the following components:

- 95 wt% of a tetrafluoroethylene pentamer;
- 1 wt% of a tetrafluoroethylene tetramer; and
- 4 wt% of a tetrafluoroethylene hexamer.

Example 4

A refrigerant includes, in percentage by weight, the following components:

- 87 wt% of a tetrafluoroethylene pentamer;
- 6 wt% of a tetrafluoroethylene tetramer; and
- 7 wt% of a tetrafluoroethylene hexamer.

Example 5

A refrigerant includes, in percentage by weight, the following components:

- 90 wt% of a tetrafluoroethylene pentamer;
- 2 wt% of a tetrafluoroethylene tetramer; and
- 8 wt% of a tetrafluoroethylene hexamer.

Example 6

A refrigerant includes, in percentage by weight, the following components:

- 93 wt% of a tetrafluoroethylene pentamer;
- 1.4 wt% of a tetrafluoroethylene tetramer; and
- 5.6 wt% of a tetrafluoroethylene hexamer.

Example 7

A refrigerant includes, in percentage by weight, the following components:

- 97 wt% of a tetrafluoroethylene pentamer;
- 0.5 wt% of a tetrafluoroethylene tetramer; and
- 2.5 wt% of a tetrafluoroethylene hexamer.

Example 8

A refrigerant includes, in percentage by weight, the following components:

- 87 wt% of a tetrafluoroethylene pentamer;
- 0.85 wt% of a tetrafluoroethylene tetramer; and
- 12.15 wt% of a tetrafluoroethylene hexamer.

Example 9

A refrigerant includes, in percentage by weight, the following components:

- 87 wt% of a tetrafluoroethylene pentamer;
- 3 wt% of a tetrafluoroethylene tetramer; and

10 wt% of a tetrafluoroethylene hexamer.

Example 10

A refrigerant includes, in percentage by weight, the following components:

87 wt% of a tetrafluoroethylene pentamer;

5 wt% of a tetrafluoroethylene tetramer; and

8 wt% of a tetrafluoroethylene hexamer.

Comparative Example 1

A refrigerant includes, in percentage by weight, the following components:

60 wt% of a tetrafluoroethylene pentamer;

15 wt% of a tetrafluoroethylene tetramer;

13 wt% of a tetrafluoroethylene hexamer; and

12 wt% of a tetrafluoroethylene heptamer.

Comparative Example 2

A refrigerant includes, in percentage by weight, the following components:

70 wt% of a tetrafluoroethylene pentamer;

10 wt% of a tetrafluoroethylene tetramer;

10 wt% of a tetrafluoroethylene hexamer; and

10 wt% of a tetrafluoroethylene heptamer.

Comparative Example 3

A refrigerant includes, in percentage by weight, the following components:

87 wt% of a tetrafluoroethylene pentamer;

0 wt% of a tetrafluoroethylene tetramer; and

13 wt% of a tetrafluoroethylene hexamer.

Comparative Example 4

A refrigerant includes, in percentage by weight, the following components:

87 wt% of a tetrafluoroethylene pentamer;

7 wt% of a tetrafluoroethylene tetramer; and

6 wt% of a tetrafluoroethylene hexamer.

Formulations of the raw material components of the refrigerants of examples and comparative examples are summarized in Table 1, and different refrigerants are prepared.

Table 1 Formulations of the refrigerants with different weight ratios of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer

Mass percentage	Pentamer	Tetramer	Hexamer	Heptamer
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wt% Example No.				
Example 1	90	1	9	0
Example 2	92	2	6	0
Example 3	95	1	4	0
Example 4	87	6	7	0
Example 5	90	2	8	0
Example 6	93	1.4	5.6	0
Example 7	97	0.5	2.5	0
Example 8	87	0.85	12.15	0
Example 9	87	3	10	0
Example 10	87	5	8	0
Comparative Example 1	60	15	13	12
Comparative Example 2	70	10	10	10
Comparative Example 3	87	0	13	0
Comparative Example 4	87	7	6	0

Test Example:

The prepared refrigerants were subjected to the following performance tests. Test results are shown in Table 2. Boiling point test: The test was conducted with reference to GB/T 6536-2010.

Kinematic viscosity: The kinematic viscosity was tested at 25°C using a viscometer with reference to a national standard.

Saturated vapor pressure test method: The test was conducted with reference to NB/SH/T 0769-2019.

Table 2 Performance data of the refrigerants prepared in examples and comparative examples

Example No.	Boiling point (°C)	Kinematic viscosity at 25°C	Kinematic viscosity at -20°C	Saturated vapor pressure (80°C,
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		mm ² /s	mm ² /s	KPa)
Example 1	135	1.26	5.6	17.2
Example 2	128	1.23	5.1	17.8
Example 3	125	1.15	5	18
Example 4	145	1.37	5.6	18.4
Example 5	128.2	1.25	5.5	17.5
Example 6	125.8	1.23	5.3	17.3
Example 7	126	1.08	4.8	18.2
Example 8	158	1.98	6	16.7
Example 9	153	1.78	5.9	16.9
Example 10	151	1.39	5.7	17.4
Comparative Example 1	173	2.9	6.8	19.8
Comparative Example 2	165	2.8	6.5	19.3
Comparative Example 3	159	2.11	6.3	16.3
Comparative Example 4	143	1.37	5.5	18.8

In Table 2, the boiling point refers to the temperature at initial distillation of 5%. It can be seen that the viscosity of the tetrafluoroethylene oligomer refrigerant of the present invention is lower than that of comparative examples, and the viscosity is especially lower at a low temperature. The refrigerant has a suitable boiling point and fluidity, making it more suitable for use in a semiconductor manufacturing process and energy storage. When the proportion of the tetramer is increased, the boiling point is decreased, and the operating vapor pressure is high during use at a high temperature, easily resulting in cavitation. When the proportion of the hexamer is increased, the viscosity is increased, and the resistance is high during use at a low temperature, resulting in increased pump operating power and decreased application effects.

Application Example 1

Dual-channel MPX-45FG simulation test equipment was used to simulate a semiconductor manufacturing process. The different refrigerants of the above examples were respectively loaded into a chiller of the MPX-45FG simulation test equipment, and a dual-loop PID control algorithm technology was used to test temperature control effects of the refrigerants of different examples during the simulation of the semiconductor manufacturing process (a working temperature was set at 40°C, operation was started, and after stable operation of the equipment for 30 min, temperature changes of the refrigerants of different examples were respectively recorded within 4,000 s). Test results are shown in Table 3, where the comparison of the temperature stability of Example 3 and Comparative Examples 1-4 at 40°C is shown in FIG. 1.

Table 3 Temperature control situations of the refrigerants prepared in examples and comparative examples during the simulation of the semiconductor manufacturing process

Example No.	Temperature fluctuation frequency	Temperature fluctuation error
	(number of times) (within 4,000 s)	(°C)
Example 1	2	-0.1~0.1
Example 2	1	0.1
Example 3	0	0
Example 4	3	-0.1
Example 5	1	-0.1
Example 6	0	0
Example 7	0	0
Example 8	2	-0.2~0
Example 9	1	0.1
Example 10	3	-0.2~0.1
Comparative Example 1	7	-0.3~0.1
Comparative Example 2	6	-0.3~0.2
Comparative Example 3	2	-0.1~0.1

Comparative Example 4	7	-0.2~0.3
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It can be seen from Table 3 and FIG. 1 that when the tetrafluoroethylene oligomer proposed in the present invention is used as the refrigerant in the simulation of the semiconductor manufacturing process, the temperature fluctuation frequency is lower, the temperature fluctuation error is smaller, and the temperature control effect is better.

Application Example 2

Material compatibility test for an energy storage box and an energy storage battery themselves: By means of an accelerated aging test method, main materials involved in the energy storage box and the energy storage battery were respectively immersed in containers filled with the refrigerants of the above examples, then the containers were placed in a thermostatic chamber for heat preservation at 80°C for 1,000 h, sampling was performed once every 200 h, mass change rates of sampled materials were tested as mass change rate = (increased or decreased mass)/original mass × 100%, and evaluation was performed according to evaluation criteria in Table 4. Evaluation results are shown in Table 5.

Table 4 Compatibility test criteria

Evaluation result	Mass change rate
Class A+ (excellent +)	$X \leq 0.3\%$
Class A (excellent)	$0.3\% < X \leq 0.7\%$
Class A- (excellent -)	$0.7\% < X \leq 1\%$
Class B (good)	$1\% < X \leq 3\%$
Class C (pass)	$3\% < X \leq 5\%$
Class D (fail)	$X > 5\%$

Table 5 Compatibility test results of the refrigerants with the energy storage box and the energy storage battery

Test material	Exempl e 1	Exempl e 2	Exempl e 3	Exempl e 4	Comparativ e Example 1	Comparativ e Example 2
Ethylene propylene diene monomer	C	C	C	C	D	D

(EPDM)						
Silicone rubber (SIR)	C	C	C	C	D	D
Polyethylene (PE)	A-	A-	A-	A-	D	D
Polycarbonate (PC)	A-	A-	A-	A-	B	C
Polyethylene terephthalate (PET)	A-	A-	A-	A-	A-	B
Polyamide (PA)	B	B	B	B	B	B-
Polyoxymethylene (POM)	A+	A+	A+	A	A	A-
Silica gel	C	C	C	C	D	D
Polyimide (PI)	A-	A-	A	A-	B	B
Polymethyl methacrylate (PMMA)	C	C	C	C	D	D
Thermoplastic vulcanizate (TPV)	B	B	A-	B	C	C
Industrial liquid crystal polymer (LCP)	A+	A+	A+	A	B	C
Optical fiber & coating layer	A-	A-	A-	A-	B	B-
Copper	A+	A+	A+	A+	A	A-
Aluminum	A+	A+	A+	A+	A	A-
Zinc alloy	A-	A-	A-	A-	A-	B

It can be seen from Table 5 that the tetrafluoroethylene oligomer used as the refrigerant in the present invention has better material compatibility and miscibility with the main materials involved in the energy storage box and the energy storage battery, and has high chemical stability without causing swelling or corrosion to the equipment

materials after long-term immersion cooling contact.

The preferred embodiments of the present invention have been described in detail above, but the present invention is not limited thereto. Within the scope of the technical concept of the present invention, various simple modifications can be made to the technical solutions of the present invention, including combinations of respective technical features in any other suitable methods. Such simple modifications and combinations should also be regarded as the contents disclosed by the present invention and are all within the scope of protection of the present invention.

WHAT IS CLAIMED IS:

1. Use of a tetrafluoroethylene oligomer as a refrigerant in a semiconductor manufacturing process and energy storage, wherein the tetrafluoroethylene oligomer comprises a tetrafluoroethylene pentamer, a tetrafluoroethylene tetramer, and a tetrafluoroethylene hexamer; and

based on 100 parts by weight of the tetrafluoroethylene oligomer, the content of the tetrafluoroethylene pentamer is higher than 85 parts by weight, and a weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is lower than 1.

2. The use according to claim 1, wherein the content of the tetrafluoroethylene tetramer in the tetrafluoroethylene oligomer is more than 0.5 part by weight.

3. The use according to claim 1 or 2, wherein the content of the tetrafluoroethylene tetramer in the tetrafluoroethylene oligomer is more than 0.75 part by weight.

4. The use according to any one of claims 1-3, wherein the content of the tetrafluoroethylene tetramer in the tetrafluoroethylene oligomer is 1-6 parts by weight.

5. The use according to any one of claims 1-4, wherein the content of the tetrafluoroethylene hexamer in the tetrafluoroethylene oligomer is more than 2 parts by weight.

6. The use according to any one of claims 1-5, wherein the content of the tetrafluoroethylene hexamer in the tetrafluoroethylene oligomer is more than 3 parts by weight.

7. The use according to any one of claims 1-6, wherein the content of the tetrafluoroethylene pentamer is 90-97 parts by weight.

8. The use according to any one of claims 1-7, wherein the content of the tetrafluoroethylene pentamer is 95-97 parts by weight.

9. The use according to claim 1, wherein based on 100 parts by weight of the tetrafluoroethylene oligomer, the tetrafluoroethylene oligomer comprises 87-97 parts of the tetrafluoroethylene pentamer, 0.5-7.5 parts of the tetrafluoroethylene tetramer, and 2-14.5 parts of the tetrafluoroethylene hexamer.

10. The use according to claim 1, wherein based on 100 parts by weight of the tetrafluoroethylene oligomer, the tetrafluoroethylene oligomer comprises 87-97 parts of the tetrafluoroethylene pentamer, 0.5-6 parts of the tetrafluoroethylene tetramer, and 2.5-14 parts of the tetrafluoroethylene hexamer.

11. The use according to claim 1, wherein based on 100 parts by weight of the

tetrafluoroethylene oligomer, the tetrafluoroethylene oligomer comprises 87-97 parts of the tetrafluoroethylene pentamer, 1-6 parts of the tetrafluoroethylene tetramer, and 4-9 parts of the tetrafluoroethylene hexamer.

12. The use according to any one of claims 1-11, wherein the weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is 0.1-1/3.

13. The use according to any one of claims 1-12, wherein the weight ratio of the tetrafluoroethylene tetramer to the tetrafluoroethylene hexamer is 0.1-0.3.

14. The use according to any one of claims 1-13, wherein a boiling point of the tetrafluoroethylene oligomer is 100-200°C.

15. The use according to any one of claims 1-14, wherein the boiling point of the tetrafluoroethylene oligomer is 125-145°C.

16. The use according to any one of claims 1-15, wherein a kinematic viscosity of the tetrafluoroethylene oligomer at 25°C is less than 2 mm²/s.

17. The use according to any one of claims 1-16, wherein the kinematic viscosity of the tetrafluoroethylene oligomer at 25°C is less than 1.5 mm²/s.

18. The use according to any one of claims 1-17, wherein the semiconductor manufacturing process comprises semiconductor wafer etching, semiconductor chip processing, and semiconductor device processing.

19. The use according to any one of claims 1-18, wherein a condition of the semiconductor manufacturing process comprises a temperature of -20°C to 80°C.