

TRANSLATION

DESCRIPTION

1. Title of the Invention

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INSTRUMENTS AND WEARABLE ARTICLES
USED IN CLEAN ROOM

2. Technical Field

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The present invention relates to instruments and wearable articles, used in a clean room in the field of manufacturing semiconductor devices, and more specifically to a wafer carrier (cassette), a standard mechanical interface POD (to be abbreviated as SMIF POD hereinafter), a wafer box, a wafer basket, and wafer handling jigs, which are used for handling semiconductor wafers in a clean room, and clean room shoes which are worn by an operator in a clean room.

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3. Background Art

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Recently, as the degree of integration of semiconductor device increases, the width of a line of its circuit pattern is presently in a deep sub-micron. In the case where a circuit pattern of a line width of a deep sub-micron, the internal atmosphere of the clean room must be controlled to a cleanness of a high level. Under these circumstances, the problem of organic materials adsorbed to the surface of a wafer is recently focused, in addition to the conventional problem that particle-like dust adheres to the surface of a wafer (for example, "Gaseous Contaminants and

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Present Situation of Counter-measures Taken to Eliminate It" by Fujii, Air Cleaning Vol. 32, No. 3, P43 (1994), Japan Society of Air Cleaning).

5 The inventors of the present invention conducted intensive studies on any factors which could give rise to a source of organic material in a clean room. The result indicated that aliphatic hydrocarbons, organic carboxylic acid esters, phenols, oxides of these materials and amines are generated in very small
10 amount, from resin-made instruments such as wafer carriers and SMIF POD.

Further, according to other studies carried out by the same inventors, it was found that organic carboxylic acid esters, phenols and oxides of these
15 materials are generated in very small amount from the sole (made of resin) of a conventional clean room shoe, as a so-called out-gas.

These organic materials are adsorbed to the surfaces of wafers eventually via air streams in the
20 clean room, causing a variety of bad effects in the formation of a circuit pattern. For example, in the case where a gate oxide film is formed on the surface of a wafer while some organic materials are adsorbed on the surface of the wafer, the start of the growth of
25 the film is delayed, the sheet resistance value of the film is decreased, and the surface of the film becomes rough in projections and recesses.

4. Disclosure of Invention

The object of the present invention is to provide instruments and wearable articles, which can suppress the generation of organic materials as much as possible, when they are used in a clean room.

The inventors of the present invention examined organic materials in the atmosphere in the step of manufacturing a semiconductor device, and obtained the results shown in FIG. 1A. Further, they examined organic materials adhered to a semiconductor wafer during the step of manufacturing a semiconductor device, and obtained the results shown in FIG. 1B. When these results were taken as a whole, it was found that the detected organic materials were contained in the ordinary additives (lubricant, plasticizer, anti-oxidizing agent, antistatic agent) added to resin materials which constitute the instruments for handling substrates, such as wafer cassettes and SMIF POD.

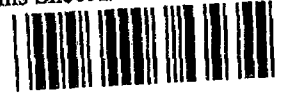
The organic materials generated from these instruments are components contained in the lubricant, plasticizer, anti-oxidizing agent, antistatic agent, etc. which are added to the resin base. They are made of relatively light molecules, and consequently they easily evaporate from the resin base during the use, as an out gas. Specifically, the aliphatic hydrocarbons are generated from the lubricant added to enhance the moldability, the organic carboxylic acid esters are

generated from the plasticizer added to maintain the material properties, the phenols and oxides thereof are generated from the anti-oxidizing agent added to prevent the deterioration due to oxidization, which
5 would occur during or after the molding process, and the amines are generated from the antistatic agent added to prevent static charge.

Further, the organic materials generated from the sole of the shoes are components contained in the
10 plasticizer, anti-oxidizing agent, antistatic agent and ultraviolet ray absorbing agent, which are added to the resin base. They are made of relatively light molecules, and consequently they easily evaporate from the resin base during the use, as an out gas.

15 In consideration of the above findings, the inventors of the present invention have completed the present invention, and with use of additives (lubricant, plasticizer, anti-oxidizing agent and antistatic agent) containing organic materials having boiling points
20 higher than those organic materials (for example, a higher boiling point than that of DOP (dioctyl phthalate), that is, organic materials having low volatility values, the amount of organic material adsorbed onto a substrate can be significantly reduced.
25 It should be noted that the judgment as to whether or not organic materials volatilize from a substrate handling instrument and are adsorbed on the surface of

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a substrate can be made by means of a wafer analyzer or the like, which will be explained later.

In the present invention, a "substrate" is meant to be an object of the manufacture of semiconductor devices, such as a silicon wafer, glass substrate or mask. Further, examples of the instrument for handling substrates are a wafer box, SMIF POD, a wafer tray, a wafer cassette, a wafer basket, a wafer handling jig, etc.. These wafer handling instruments are discussed in, for example, Jap. Pat. Appln. KOKAI Publication No. 1-222429 and U.S. Patent No. 4,534,389.

The inventors of the present invention examined organic materials in the atmosphere in the step of manufacturing a semiconductor device, and obtained the results shown in FIG. 1A. Further, they examined organic materials adhered to a semiconductor wafer during the step of manufacturing a semiconductor device, and obtained the results shown in FIG. 1B. When these results were taken as a whole, it was found that the detected organic materials match well the ordinary additives (lubricant, plasticizer, anti-oxidizing agent, antistatic agent) contained in the resin materials which constitute the instruments for handling substrates, such as wafer cassettes and SMIF POD.

In consideration of the above findings, the inventors of the present invention have completed the present invention, and with use of additives (lubricant,



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5 phthalate), that is, organic materials having low
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adsorbed onto a substrate can be significantly reduced.
It should be noted that the judgment as to whether
or not organic materials volatilize from a substrate
10 handling instrument and are adsorbed on the surface of
a substrate can be made by means of a wafer analyzer or
the like, which will be explained later.

An instrument of the present invention, used in
the clean room is an instrument used for handling
15 a substrate in a clean room at room temperature and
under atmospheric pressure, and it is characterized
by including a resin base and at least one additive
selected from the group consisting of a lubricant, a
plasticizer, an anti-oxidizing agent and an antistatic
20 agent, and that the additives does not generate a
gaseous organic component at room temperature and under
atmospheric pressure.

The wearable articles of the present invention
include shoes (of the type whose soles are covered by
25 cloth), groves, clothes (suits), glasses and the like,
which are worn by the operator in a clean room during
the manufacture of semiconductor devices. To these

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resin portion of the wearable articles, the plasticizer for enhancing the moldability and maintaining the material properties, the anti-oxidizing agent for preventing the deterioration due to oxidization, which would occur during or after the molding process, and the antistatic agent for imparting an anti-static property, and if necessary, an ultraviolet ray absorbing agent, etc. are added as additives.

The inventors of the present invention examined the organic components adhered to wafers during the manufacture of semiconductor devices, and it was found that they are components of the additives (plasticizer, anti-oxidizing agent, antistatic agent and ultraviolet ray absorbing agent) contained in the resin material which constitutes the sole of the shoe for clean room.

In consideration of the above findings, the inventors of the present invention have completed the present invention, and with use of additives (plasticizer, anti-oxidizing agent, antistatic agent and ultraviolet ray preventing agent) containing organic materials having boiling points higher than those organic materials (for example, a higher boiling point than that of 2,6-di-t-butyl-p-cresol), that is, organic materials having low volatility values (less generation of an out gas), the amount of organic material adsorbed onto a substrate can be significantly reduced. It should be noted that the judgment as to



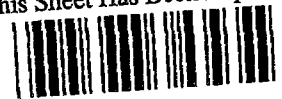
whether or not organic materials volatilize from the clean room shoe and are adsorbed on the surface of a substrate can be made by means of a wafer analyzer or the like, which will be explained later.

5 A wearable article of the present invention, used in the clean room is an article worn by the operator in a clean room at room temperature and under atmospheric pressure, and it is characterized by including a resin base and at least one additive selected from the group
10 consisting of, a plasticizer, an anti-oxidizing agent, an antistatic agent and ultraviolet ray preventing agent, and that the additives does not generate a gaseous organic component at room temperature and under atmospheric pressure.

15 5. Brief Description of Drawings

 FIG. 1A is a diagram showing a characteristic curve which indicates the measurement result of the organic materials contained in the atmosphere for processing semiconductor wafers (that is, clean room),
20 and FIG. 1B is a diagram showing a characteristic curve which indicates the measurement result of the organic materials adhered to the surface of a semiconductor wafer;

 FIG. 2A is a lateral cross sectional view showing
25 a SMIF POD (Standard Mechanical Interface POD) used for isolating a wafer carrier (cassette) from outside atmosphere, and FIG. 2B is a lateral cross sectional



view showing the SMIF POD, designed to illustrate the state of the SMIF POD in use;

FIGS. 3A and 3B are plan views showing a shoe for clean room; and

5 FIG. 4 is a side view of another shoe for clean room.

6. Best Mode of Carrying Out the Invention

Various preferable modes of the present invention will now be specifically described.

10 First, while referring to FIGS. 2A and 2B, a SMIF POD (Standard Mechanical Interface POD) will now be described.

 Jap. Pat. Appln. KOKAI Publication No. 1-222429 and U.S. Patent No. 4,534,389 each discloses a portable
15 SMIF POD 2 used for isolating a wafer W and a carrier (cassette) C from outside atmosphere. As can be seen in FIG. 2A, the SMIF POD 2 includes a box-shaped cover 3 and a disk-shaped bottom portion 10. The SMIF POD cover 3 is an integral molded form of a transparent or
20 semitransparent resin, which has a volume sufficient to contain one wafer cassette C, and at the uppermost portion thereof, a handle 6 is provided.

 In a lower section of the SMIF POD cover 3, a flange portion 4 is formed. Further, a ring-like
25 recess section 4a is made in an inner side of the flange portion 4. The bottom portion 10 of the SMIF POD has a plurality of pins 11. Each of the pins 11 is

connected to a link mechanism 12. For example, if
a member such as a projection 28 is plugged into a hole
12a of the link mechanism 12 and rotated, each pin 11
projects from the outer periphery portion of the bottom
5 portion 10 or contract within the outer peripheral
portion. That is, when the SMIF POD cover 3 is placed
on the bottom portion 10 and the pins 11 are projected,
the pins 11 are engaged to the recess section 4a,
and thus the cover 3 and the bottom portion 10 are
10 integrally jointed together.

Further, a flexible hose 5 is provided for the
side wall of the cover 3. The flexible hose 5 is
connected to a nitrogen gas supply source 8 via a valve
7, and nitrogen gas is introduced to the SMIF POD 2.
15 It should be noted that the flexible hose 5 is made of
a soft resin.

As shown in FIG. 2B, a cassette transfer mechanism
20 is provided underneath a table 19. The cassette
transfer mechanism 20 includes a vertical ball screw
mechanism 22, a support arm 24, a support table 26 and
a projecting member 28. The support table 26 is made
ascendable/discendable by the vertical ball screw
mechanism 22. The projecting member 28 has a pair of
projecting portions 28a projecting upwards from the
25 support table 26, and is supported rotatable around the
vertical central axis.

An opening 19a is made in the table 19.

A plurality of chuck members 30 are provided in the vicinity of the opening 19a.

As the SMIF POD 2 is placed on the table 19, the chuck members 30 hold the flange section 4, and thus the SMIF POD 2 is fixed onto the table 19. Subsequently, when the support table 26 is moved up, the projecting portions 28a of the projecting member 28 are plugged into the hole 12a of the link mechanism 12 via the opening 19a. Further, as the projecting member 28 is rotated, the pins 11 come off from the recess section 4a, and the engagement between the bottom portion 10 and the cover 3 is released. When the support table 26 is moved down, only the cover 3 is left on the table 19, and the cassette C and the bottom portion 10 move down together with the support table 26.

Next, the materials of the structural components of the SMIF POD 2 and the cassette C will now be described.

Each of the structural components of the SMIF POD 2 and the cassette C is made of a hard resin by injection molding. In particular, the cassette C and the cover 3 of the SMIF POD are respectively integral molded forms of a hard resin, which are made by the injection molding. It should be noted that the pins 11, the link mechanism 12, the projecting member 28, the chuck members 30 and the like may be made of metals. The flexible hose 5 is made of a composite material

obtained by reinforcing a hard resin with metal fibers.

The components of the additives added to resin substrates will now be described.

In the present invention, it is preferable that
5 the lubricant should contain as a main component, at least one aliphatic hydrocarbon having a carbon atom number of 20 or more, and higher alcohol having a carbon atom number of 18 or more, and the lubricant should not contain aliphatic hydrocarbons having a
10 carbon atom number of less than 20, or higher alcohols having a carbon atom number of less than 18. It is particularly preferable that the lubricant should contain as the main component at least one of paraffins/waxes such as micro-crystalline wax, natural
15 paraffin, synthetic paraffin and polyolefin wax; and higher alcohols such as synthetic ramificated higher alcohols having a carbon atom number of 18, 20 and 24 and natural oleyl alcohols. If the main component of the lubricant is a limphatic hydrocarbon having
20 a carbon atom number of 19 or less, it volatilizes from the substrate handling instrument at a normal temperature of a clean room (room temperature of 23°C), and is adsorbed on a substrate, thus contaminating the surface of the substrate. Therefore, it is not preferable.

25 In the present invention, it is preferable that the main component of the plasticizer should be one of carboxylic acid ester having a molecular weight of 420

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or higher, a polyester having a molecular weight of 400 or higher and an epoxy-based compound having a molecular weight of 400 or higher. Further, it is particularly preferable that the main component of the plasticizer should be at least one of phthalic ester-based compounds such as di-isodecyl phthalate (molecular weight: 447) and dilauryl phthalate (molecular weight: 502); aliphatic dibasic acid ester-based compounds such as di-2-ethylhexyl azelate (molecular weight: 413) and di-2-ethylhexyl sebacate (molecular weight: 427); trimellitate ester-based compounds such as tris-2-ethylhexyl trimellitate (molecular weight: 547) and trioctyl trimellitate (molecular weight: 547); polyester-based compounds which are polymers obtained by reactions between dibasic acids such as adipic acid, azelaic acid, sebacic acid and phthalic acid, and glycol or glycerin, especially, propylene glycol adipate-based compounds or butylene glycol adipate-based compounds each having a molecular weight of 2000 to 8000; and epoxy-based compounds such as epoxy fatty ester-based compounds (molecular weight: 400 to 500) and epoxy oil (molecular weight: about 1000).

It should be noted that if the main component of the plasticizer is dibutyl phthalate (molecular weight: 278), dioctyl phthalate (molecular weight: 391) or di-2-ethylhexyl adipate (molecular weight: 371), having

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a molecular weight of less than 420, it volatilizes from the substrate handling instrument at a normal temperature of a clean room (23°C), and is adsorbed on a substrate. Therefore, it is not preferable.

5 In the present invention, it is preferable that the main component of the anti-oxidizing component should be a phenol-based compound having a molecular weight of 300 or higher. It is particularly preferable that the main component of the anti-oxidizing agent
10 should be at least one of monophenol-based compounds such as stearyl- β -(3, 5-di-t-butyl-4-hydroxyphenyl) propionate (molecular weight: 520.9); bisphenol-based compounds such as 2,2'-methylene-bis-(4-methyl-6-t-butylphenol) (molecular weight: 340.5),
15 2,2'-methylene-bis-(4-ethyl-6-t-butylphenol) (molecular weight: 368.5), 4,4'-thiobis-(3-methyl-6-t-butylphenol) (molecular weight: 358.5), 4,4'-butylidenbis-(3-methyl-6-t-butylphenol) (molecular weight: 382.6); and high-molecule phenol-based
20 compounds such as 1,1,3-tris-(2-methyl-4-hydroxy-5-t-butylphenol)butane (molecular weight: 544.8), 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene (molecular weight: 775.2), tetrakis-[methylene-3-(3',5'-di-t-butyl-4'-hydroxyphenyl) propionate] methane (molecular weight:
25 1177.7), bis-[3,3'-bis-(4'-hydroxy-3'-t-butylphenyl) butylic acid] glycol ester (molecular weight: 794.4).

If the main component of the anti-oxidizing agent is 2,6-di-t-butyl-p-cresol (molecular weight: 220.4) or 2,6-di-t-butyl-4-ethylphenol (molecular weight: 234.2), which has a molecular weight of less than 300, it
5 volatilizes from the substrate handling instrument at a normal temperature of a clean room (23°C), and is adsorbed on a substrate. Therefore, it is not preferable.

In the present invention, it is preferable that
10 the main component of the antistatic agent should be a nonion-based compound having a molecular weight of 350 or higher. It is particularly preferable that the nonion-based compound should be at least one of polyoxyethylenealkylamine, polyoxyethylenealkylamide,
15 polyoxyethylenealkylether, polyoxyethylenealkylphenylether, and N,N'-bis-(diethylene glycol) stearyl amine.

In the main component of the anti-static agent, the molecular weight is calculated from the carbon atom
20 number of the alkyl group and/or the number of bonding of polyoxyethylene.

If the main component of the anti-static agent is N,N'-bis-(2-hydroxyethyl) lauryl amide (molecular weight: 273), it volatilizes from the substrate
25 handling instrument at a normal temperature of a clean room (23°C), and is adsorbed on a substrate. Therefore, it is not preferable.

As described above, with use of the aforementioned compounds as the main components of the additives, that is, the lubricant, plasticizer, anti-oxidizing agent and anti-static agent, the volatilization of the component from the substrate handling instrument can be prevented, thus making it possible to prevent the contamination of the substrate. It should be noted that when the main component of at least one of the additives including lubricant, plasticizer, anti-oxidizing agent and anti-static agent is the above-listed compound, the contamination of the substrate can be reduced.

In the present invention, it is preferable that the resin base should be one selected from the group consisting of polyolefins such as polyethylene and polypropylene, and fluorine resins such as polycarbonate and tetrafluoroethylene-perfluoroalcoxyethylene copolymer (PFA).

Examples of the preferable materials used for the instruments of the present invention are those using polypropylene as the resin material, and containing as the additives, a lubricant having microcrystalline wax as the main component, a plasticizer having di-2-ethylhexyl sebacate as the main component, an anti-oxidizing agent having tetrakis-[methylene-3-(3',5'-di-t-butyl-4'-hydroxyphenyl) propionate] methane as the main component and, if necessary, an anti-static

agent which is an ethylene oxide adduct having stearyl amide as the main component.

In the present invention, the instruments for handling substrates are formed of the above-described resin material and additives, by adding a predetermined
5 amount of each additive to the resin base, followed by kneading with heat, and subjecting such a resin composition to injection molding.

Examples which were carried out to clarify the effect of the present invention will now be described.
10

(Example 1)

To 100 parts by weight of polypropylene (average molecular weight: 100,000, a product of MITSUI TOATSU KAGAKU), 5 parts by weight of a lubricant (molecular
15 weight: 420, NIHON SEKIYU), 3 parts by weight of a plasticizer (molecular weight 427; DAIHACHI KAGAKU KOGYO), 1 part by weight of an anti-oxidizing agent (molecular weight: 521, YOSHITOMI SEIYAKU KOGYO), 2 parts by weight of an anti-static agent (average
20 molecular weight: 440, LION) were added, and they were kneaded while heating. With use of the material, injection molding was carried out to manufacture a wafer carrier having dimensions of 208 mm in vertical direction $\times$ 236 mm in lateral direction $\times$ 215 mm in
25 height, and having a pitch between wafers of 6.35 mm. It should be noted that the main component of the lubricant was micro-crystalline was, the main component

of the plasticizer was di-2-ethylhexyl sebacate, the main component of the anti-oxidizing agent was stearyl- β -(3,5-di-*t*-butyl-4-hydroxyphenyl) propionate, and the main component of the anti-static agent was N,N'-bis-
5 (diethyleneglycol)stearylamine(stearyldiethyleneglycol amine).

A portion (40g) was cut out from the thus obtained wafer carrier. With regard to the sample, organic materials of the additives which were adsorbed on
10 a wafer were examined using Silicon Wafer Analyzer (tradename, to be abbreviated as "SWA" hereinafter, product of GL Science).

The SWA consists of roughly three devices, more specifically, a trap device for heat-desorbing adsorbed
15 components from a wafer to which organic materials were adsorbed, in a helium gas stream, and re-trapping them, a thermal desorption cold trap injector (TCT) device for introducing the re-trapped organic components into a capillary tube which is cooled down with liquid
20 nitrogen, while heat-desorbing the organic components, so as to trap them to be concentrated, and a gas chromatography/mass spectrum (GC/MS) for analyzing the cooled and concentrated components by rapidly heating them in a helium gas stream. By the GC/MS device,
25 a total ion chromatogram (TIC) in which the organic components are separated by the GC device, can be obtained. For each of the peaks, the organic

components are subjected to quantitative analysis by the MS device. With the SWA, it is possible to measure the contents and types of organic materials adsorbed to a wafer. Further, according to the SWA, the analysis
5 can be carried out in an order of several ng(10^{-9} g) per wafer.

The measurement of organic materials of the additives, which were adsorbed to a wafer, was carried out in the following manner. First, a portion of a
10 wafer carrier and a 4-inch silicon wafer whose surface was washed, were placed in a common desiccator to be several centimeters away from each other. A cover is placed on the desiccator and let it stand for several hours (for example, 6 hours). The wafer to which
15 organic materials were adsorbed was inserted to the SWA, where the adsorbed organic materials were desorbed by heating the wafer at 315°C under a helium gas stream, and then trapped once by the trap device. Next, the trapped organic materials were heat-adsorbed in the
20 helium gas stream, and then cooled down with liquid nitrogen in the TCT device to be concentrated. After that, the cooled and concentrated organic components were heated to 280°C in a helium gas stream, and the organic components were introduced into the GC/MS
25 device.

As the GC/MS device, G-3000/M-80B (tradename, products of HITACHI) was used, under the measurement

conditions that a range was set to be 40°C to 280°C (left for 40 minutes), and the temperature increasing rate was set to 10°C per minute. The column used had specifications: 100% methylpolysiloxane, a length of 5 60m, an inner diameter of 0.25 mm, and a film thickness of 0.25 μ m. The ionizing method of the MS device was the electron impact method, and the detection range was set to be 0 to 600 in m/z. It should be noted that the quantitative analysis was carried out on the basis of 10 the analytical curve formed with hexadecane and the concentration converted with regard to hexadecane.

As a result, it was 5 ng/wafer in hexadecane conversion. Further, the peaks of TIC were subjected to quantitative analysis; however the peaks were so 15 minute (the adsorption of the organic material very much less) that the quantitative analysis was not possible. That is, the volatilization of the compounds of the additives from the wafer carrier which is a substrate handling instrument, is less, and therefore 20 wafers are not contaminated.

Next, 5 test pieces of 45 × 45 mm were cut from the wafer carrier, and with use of these samples, the static property was examined by an electrostatic measurement device, Static Honest Meter (tradename, 25 product of Shishido Static). The static property was evaluated by static voltage and half value period.

The electrostatic measurement device mainly

consists of an application unit for charging a test piece arbitrarily, a turntable for inducing a corona discharge, a receiving unit for detecting a voltage of a test piece and an amplifier.

5 First, the half value period measurement device was connected to a synchroscope or a recording meter. The voltage applied was set to ± 10 kV, the distance from the tip end of the needle electrode of the application unit to the surface of the turntable was
10 20 mm, and the distance from the electrode of the receiving unit to the turntable was set to 15 mm. In the case where a test piece is extremely thick, the distance from the tip end of the needle of the application unit to the surface of the test piece and
15 the distance from the electrode plate of the receiving unit thereto, should be set to 20 mm or 15 mm. Such conditions are added to the results.

 Next, the test piece was discharged by means of a discharger, and then the test piece was mounted to a
20 mount frame such that the surface thereof faces upwards. As the turntable was rotated, the application of a voltage of +10 kV was carried out for 30 seconds, and after that, the application of the voltage was stopped. Then, while the rotation of the turntable was
25 maintained, the time required for which the charge voltage decays to 1/2 of the initial charge voltage was measured. It should be noted that in the case where it

takes 120 seconds or more for the initial charge voltage to attenuate to negative, the measurement was stopped at 120 seconds. For the rest of the four pieces, the measurement was carried out in the same manner. The result indicated that the charge property was 0V, and therefore the half value period was not observed.

(Example 2)

A wafer carrier was manufactured in the same manner as in Example 1, except that natural paraffin (having a carbon atom number of 22 or more) was used as the main component of the lubricant, 2,2'-methylene-bis-(4-methyl-6-t-butylphenol) was used as the main component of the anti-oxidizing agent, and N,N'-bis-(diethyleneglycol) stearyl amine was used as the main component of the anti-static agent.

The wafer carrier was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 1. As a result, the adsorption amount of wafer was as very small as 7 ng. Further, the peaks of the TIC were subjected to the quantitative analysis; however the peaks were so minute (the adsorption of organic material is very small) that the quantitative analysis was not possible. Further, the charge voltage was 0V, and therefore the half value period was not observed.

(Example 3)

A wafer carrier was manufactured in the same manner as in Example 1, except that synthetic paraffin (having a carbon atom number of 24 or more) was used as the main component of the lubricant, di-isodecyl trimellitate was used as the main component of the plasticizer, 1,1,3-tris-(2-methyl-4-hydroxy-5-t-butylphenol) butane was used as the main component of the anti-oxidizing agent, and N,N'-bis-(diethyleneglycol) stearyl amine was used as the main component of the anti-static agent.

The wafer carrier was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 1. As a result, the adsorption amount of wafer was as very small as 3 ng. Further, the peaks of the TIC were subjected to the quantitative analysis; however the peaks were so minute (the adsorption of organic material is very small) that the quantitative analysis was not possible. Further, the charge voltage was measured by a rotary static tester, and it was 0V; therefore the half value period was not observed.

(Comparative Example 1)

A wafer carrier of Fluoroware Co. was prepared. The wafer carrier was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 1. As a result, the

adsorption amount of wafer was as very large as 173 ng. Further, the peaks of the TIC of this case by the GC/MS method were subjected to the quantitative analysis, and in the analysis, aliphatic hydrocarbons each having
5 a carbon atom number of up to 18, higher alcohols having a carbon atom number of up to 16, aliphatic aldehydes having a carbon atom number of up to 12, 2,6-bis-(1,1-dimethylethyl)-4-methylphenol and oxide products, dioctyl adipate, and dioctyl phthalate, were
10 observed.

Further, the charge voltage was 1560V, and the half value period was 120 seconds or longer.

(Comparative Example 2)

To 100 parts by weight of polypropylene (a product
15 of MITSUI TOATSU KAGAKU), 3 parts by weight of a lubricant (NIHON SEKIYU), 3 parts by weight of a plasticizer (DAIHACHI KAGAKU KOGYO), 2 parts by weight of an anti-oxidizing agent (YOSHITOMI SEIYAKU KOGYO), 1.5 parts by weight of an anti-static agent (LION) were
20 added, and they were kneaded while heating. With use of the material, injection molding was carried out to manufacture a wafer carrier having dimensions of 208 mm in vertical direction × 236 mm in lateral direction × 215 mm in height, and having a pitch between wafers of
25 6.35 mm. It should be noted that the main component of the lubricant was fluidic paraffins (having a carbon atom number of 12 to 18), the main component of the

plasticizer was di-octyl phthalate (molecular weight: 391), the main component of the anti-oxidizing agent was 2,6-bis-t-butyl-p-cresol (molecular weight: 220), and the main component of the anti-static agent was
5 N,N'-bis-(2-hydroxyethyl) laurylamide (molecular weight:270). The wafer carrier was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 1. As a result, the adsorption amount of wafer was as
10 very large as 216 ng.

Further, the peaks of the TIC of this case by the GC/MS method were subjected to the quantitative analysis, and in the analysis, aliphatic hydrocarbons each having a carbon atom number of 12 to 18, di-octyl
15 phthalate, 2,6-di-t-butyl-p-cresol, and N,N'-bis(2-hydroxyethyl) laurylamide and the like, were observed.

Further, the charge voltage was 0V, and the half value period was not observed.

The above examples were described in connection
20 with the case where the present invention was applied to the instruments for handling silicon wafers and the wearable articles; however the present invention is not limited to these examples, but can be applied to the case for other substrates such as LCD glass substrate
25 and exposure mask.

Next, a shoe for a clean room, as an example of the wearable articles, will now be described with

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reference to FIGS. 3A and 3B and FIG. 4.

A shoe for clean room is disclosed in Jpn. Pat. Appln. KOKAI Publication No. 7-297257. As shown in FIGS. 3A and 3B, a shoe 50 for a clean room includes
5 a pair of flexible tab members 51, velcro fasteners 52, a flexible cover 53, an ordinary fastener 54 and a sole 56. The velcro fasteners 52 are adhered, one to the front surface of one of the tab members 51 and the other to the rear surface of the other tab member 51.
10 The ordinary fastener 54 is sewn to matching edges of the flexible cover 53. The fasteners 53 and 54 are designed to fasten up or open the flexible cover 53.

Further, the sole 56 is adhered or stitched to the other edge of the flexible cover 53. The sole 56 is
15 made of an urethane resin, and a material containing at least one of the group consisting of additives such as a sponging agent for sponging the urethane resin, a silicon-based sponging controlling agent which does not substantially generate siloxane of low molecular,
20 a plasticizer, an anti-oxidizing agent, an anti-static agent and a UV ray absorbing agent. It should be noted that as shown in FIG. 4, there is another type of shoe 50A, in which a flexible cover 53A without a zip fastener is fixed onto a sole 56A.

25 In the case where the sole 56 of a clean room shoe is manufactured using the above-described resin base and additives, a predetermined amount of additive is

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added to a resin material, and kneaded while heating. Then, the resin composition is subjected to injection molding.

In the present invention, it is preferable that
5 the main component of the plasticizer should be one of
a calboxylate having a molecular weight of 400 or more,
a polyester having a molecular weight of 400 or more,
and an epoxy-based compound having a molecular weight
of 400 or more. It is particularly preferable that the
10 main component of the plasticizer should be at least
one of phthalic acid ester-based compounds such as
isononyl phthalate (molecular weight: 418), octidecyl
phthalate (molecular weight: 419), isodecyl phthalate
(molecular weight: 447), and lauryl phthalate
15 (molecular weight: 502); aliphatic dibasic acid
ester-based compounds such as di-2-ethylhexyl azelate
(molecular weight: 413) and di-2-ethylhexyl sebacate
(molecular weight: 427); trimellitate ester-based
compounds such as tris-2-ethylhexyl trimellitate
20 (molecular weight: 547) and trioctyl trimellitate
(molecular weight: 547); polyester-based compounds
which are polymers obtained by reactions between
dibasic acids such as adipic acid, azelaic acid,
sebacic acid and phthalic acid, and glycol or glycerin,
25 especially, propylene glycol adipate-based compounds or
butylene glycol adipate-based compounds each having
a molecular weight of 2000 to 8000; and epoxy-based

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compounds such as epoxy fatty ester-based compounds (molecular weight: 400 to 500) and epoxy oil (molecular weight: about 1000).

5 It should be noted that if the main component of the plasticizer is dibutyl phthalate (molecular weight: 278), dioctyl phthalate (molecular weight: 391) or di-2-ethylhexyl adipate (molecular weight: 371), having a molecular weight of less than 400, it volatilizes from the sole of the shoe at a normal temperature of
10 a clean room (23°C), and is adsorbed on a wafer. Therefore, it is not preferable.

In the present invention, it is preferable that the main component of the anti-oxidizing component should be a phenol-based compound having a molecular
15 weight of 300 or higher. It is particularly preferable that the main component of the anti-oxidizing agent should be at least one of monophenol-based compounds such as stearyl- β -(3, 5-di-t-butyl-4-hydroxyphenyl) propionate (molecular weight: 520.9); bisphenol-based
20 compounds such as 2,2'-methylene-bis-(4-methyl-6-t-butylphenol) (molecular weight: 340.5), 2,2'-methylene-bis-(4-ethyl-6-t-butylphenol) (molecular weight: 368.5), 4,4'-thiobis-(3-methyl-6-t-butylphenol) (molecular weight: 358.5), 4,4'-butylidenbis-(3-methyl-
25 6-t-butylphenol) (molecular weight: 382.6); and high-molecule phenol-based compounds such as 1,1,3-tris-(2-methyl-4-hydroxy-5-t-butylphenol)butane

(molecular weight: 544.8), 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene (molecular weight: 775.2), tetrakis-[methylene-3-(3',5'-di-t-butyl-4'-hydroxyphenyl) propionate] methane (molecular weight: 1177.7), bis-[3,3'-bis-(4'-hydroxy-3'-t-butylphenyl) butyric acid] glycol ester (molecular weight: 794.4).

If the main component of the anti-oxidizing agent is 2,6-di-t-butyl-p-cresol (molecular weight: 220.4) or 2,6-di-t-butyl-4-ethylphenol (molecular weight: 234.2), which has a molecular weight of less than 300, it volatilizes from the sole of the ordinary clean room at a normal temperature of a clean room (23°C), and is adsorbed on a wafer. Therefore, it is not preferable.

In the present invention, it is preferable that the main component of the antistatic agent should be a nonion-based compound having a molecular weight of 350 or higher. It is particularly preferable that the nonion-based compound should be at least one of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether, and N,N'-bis-(diethylene glycol) stearyl amine. In the main component of the anti-static agent, the molecular weight is calculated from the carbon atom number of the alkyl group and/or the number of bonding of polyoxyethylene.

If the main component of the anti-static agent is N,N'-bis-(2-hydroxyethyl) lauryl amide (molecular weight: 273), it volatilizes from the sole of the clean room shoe at a normal temperature of a clean room (23°C), and is adsorbed on a wafer. Therefore, it is not preferable.

In the present invention, it is preferable that the main component of the ultraviolet ray absorbing agent should be a compound having a molecular weight of 300 or more. It is preferable that the main component of the ultraviolet absorbing agent should be one of a salicylate-based compound such as p-octylphenylsalicylate (molecular weight: 326), benzophenone-based compounds such as 2-hydroxy-4-octoxybenzophenone (molecular weight: 326), 2-hydroxy-4-dodecyloxybenzophenone (molecular weight: 382); and benzotriazol-based compounds such as 2-(2'-hydroxy-3'-t-butyl-5'-methylphenyl)-5-chlorobenzotriazol (molecular weight: 315), 2-(2'-hydroxy-3',5'-di-t-butylphenyl)-5-chlorobenzotriazol (molecular weight: 361), 2-(2'-hydroxy-3',5'-di-t-amylphenyl)benzotriazol (molecular weight: 334), 2-(2'-hydroxy-3'-(3'',6'',5'',6''-tetrahydrophthalimidemethyl)-5-methylphenyl)benzotriazol (molecular weight: 388), and the like. It should be noted that the ultraviolet absorbing agent may not be used in the case where

a resin material having an excellent weathering resistance, such as polyvinyl chloride, is used.

In the present invention, it is preferable that the resin material should be polyvinyl chloride resin or urethane resin. These resins are preferable because each has a flexibility and a resiliency, which are necessary for the shoe sole, and further has a less out gas amount of organic materials of each resin.

Further, the present invention provides a clean room shoe having a sole made of an urethane resin and a material containing at least one of the group consisting of additives such as, a sponging agent for sponging the urethane resin, a silicon-based sponging controlling agent which does not substantially generate siloxane of low molecular, a plasticizer, an anti-oxidizing agent, an anti-static agent and a UV ray absorbing agent, which is characterized in that the additives do not generate gaseous organic material.

In this case, it is preferable that the silicon-based sponging controlling agent should be at least one of dimethylpolysiloxane which does not substantially contain cyclic siloxane having a silicon atom number of 10 or less and dimethylpolysiloxane-polyocyalkylene copolymer. Such compounds can be obtained by eliminating cyclic siloxanes having a silicon atom number of 10 less by heating a commercially available silicon-based sponge controlling agent while

vacuum-deaerating it.

Preferable examples of the material for the clean room shoe of the present invention are those containing polyvinyl chloride, vinyl chloride-based elastomer and chlorinated polyethylene resin as a resin base, a plasticizer whose main component is tris-2-ethylhexyl trimellitate, an anti-oxidizing agent whose main component is 2,2'-methylene-bis-(4-ethyl-6-t-butylphenol) and an antistatic agent whose main component is an ethyleneoxide adduct of stearylamine, and those using a urethane resin as a resin material, and containing additives a plasticizer whose main component is di-2-ethylhexyl sebacate, an anti-oxidizing agent whose main component is 2,2'-methylene-bis-(4-ethyl-6-t-butylphenol), an antistatic agent whose main component is a polyethyleneglycol-p-nonylphenol, and an ultraviolet ray absorbing agent whose main component is 2-(2'-hydroxy-3',5'-di-t-amylphenol) benzotriazol. It should be noted that when sponging the urethane resin, it is preferable that dimethylpolysiloxane-polyoxyalkylene co-polymer which was treated at a degree of vacuum of 10 mmHg at 150°C for 3 hours should be used together with a sponging agent.

Next, an example which was carried out so as to clarify the effect of the present invention will now be described.

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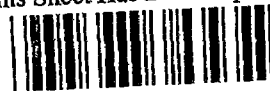
(Example 4)

To 100 parts by weight of pre-polymer for polyurethane and a hardener (having an average molecular weight of 4000; a product of MITSUI TOATSU KAGAKU), 5 parts by weight of a plasticizer (having a molecular weight of 427; DAIHACHI KAGAKU KOGYO), 0.5 parts by weight of an anti-oxidizing agent (having a molecular weight of 340; YOSHITOMI SEIYAKU KOGYO), 1 part by weight of an anti-static agent (having an average molecular of 450; LION), and 0.5 parts by weight of an ultraviolet ray absorbing agent (having a molecular weight of 334; CHIBA GAIGI CO.) were added, and they were kneaded while heating. Further, to this material, water serving as a sponging agent was added, and dimethylpolysiloxane-polyoxyalkylene co-polymer (having an average molecular weight of 1800; SHINETU KAGAKU KOUGYOU) was further added as a sponging agent. It should be noted that dimethylpolysiloxane-polyoxyalkylene co-polymer used here was treated at a degree of vacuum of 10 mmHg at 150°C for 3 hours. With use of this material, the injection molding was carried out, and thus a flat plate having dimensions of 100 × 100 mm and a thickness of 10 mm was obtained.

In this case, the main component of the plasticizer was di-2-ethylhexyl sebacate, the main component of the anti-oxidizing agent was 2,2'-methylene-bis-(4-ethyl-6-t-butylphenol), the main



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component of the antistatic agent was polyethyleneglycol-p-nonylphenyl ether, and the main component of the ultraviolet ray absorbing agent was 2-(2'-hydroxy-3',5'-di-t-amylphenol) benzotriazol.

5 A portion (40g) was cut out from the thus obtained wafer carrier. With regard to the sample, organic materials of the additives which were adsorbed on a wafer were examined using Silicon Wafer Analyzer (tradename, to be abbreviated as "SWA" hereinafter,
10 product of GL Science).

 The SWA consists of roughly three devices, more specifically, a trap device for heat-desorbing adsorbed components from a wafer to which organic materials were adsorbed, in a helium gas stream, and re-trapping them,
15 a thermal desorption cold trap injector (TCT) device for introducing the re-trapped organic components into a capillary tube which is cooled down with liquid nitrogen, while heat-desorbing the organic components, so as to trap them to be concentrated, and a gas
20 chromatography/mass spectrum (GC/MS) for analyzing the cooled and concentrated components by rapidly heating them in a helium gas stream. By the GC/MS device, a total ion chromatogram (TIC) in which the organic components are separated by the GC device, can be
25 obtained. For each of the peaks, the organic components are subjected to quantitative analysis by the MS device. With the SWA, it is possible to measure

the contents and types of organic materials adsorbed to a wafer. Further, according to the SWA, the analysis can be carried out in an order of several ng(10^{-9} g) per wafer.

5 The measurement of organic materials of the additives, which were adsorbed to a wafer, was carried out in the following manner. First, a portion of a wafer carrier and a 4-inch silicon wafer whose surface was washed, were placed in a desiccator to be several
10 centimeters away from each other. A cover is placed on the desiccator and let it stand for several hours (for example, 6 hours). The wafer to which organic materials as out-gas were adsorbed was inserted to the SWA, where the adsorbed organic materials were desorbed
15 by heating the wafer at 315°C under a helium gas stream, and then trapped once by the trap device. Next, the trapped organic materials were heat-adsorbed in the helium gas stream, and then cooled down with liquid nitrogen in the TCT device to be concentrated. After
20 that, the cooled and concentrated organic components were heated to 280°C in a helium gas stream, and the organic components were introduced into the GC/MS device.

 As the GC/MS device, G-3000/M-80B (tradename, products of HITACHI) was used, under the measurement
25 conditions that a range was set to be 40°C to 280°C (left for 40 minutes), and the temperature increasing

rate was set to 10°C per minute. The column used had specifications: 100% methylpolysiloxane, a length of 60m, an inner diameter of 0.25 mm, and a film thickness of 0.25 μ m. The ionizing method of the MS device was the electron impact method, and the detection range was set to be 0 to 600 in m/z. It should be noted that the quantitative analysis was carried out on the basis of the analytical curve formed with hexadecane and the concentration converted with regard to hexadecane.

As a result, it was 5 ng/wafer in hexadecane conversion. Further, the peaks of TIC were subjected to quantitative analysis; however the peaks were so minute (the adsorption of the organic material very much less) that the quantitative analysis was not possible. That is, the volatilization of the compounds of the additives from the wafer carrier which is a substrate handling instrument, is less. In this embodiment, the evaluation was made not in the form of sole, but in the form of a flat plate, so as to facilitate the analysis. Further, separately it was confirmed that the material used here could be formed into a shape of a sole without problem.

Next, 5 test pieces of 45 × 45 mm were cut from the wafer carrier, and with use of these samples, the static property was examined by an electrostatic measurement device, Static Honest Meter (tradename, product of Shishido Static). The static property was

evaluated by static voltage and half value period.

The electrostatic measurement device mainly consists of an application unit for charging a test piece arbitrarily, a turntable for inducing a corona discharge, a receiving unit for detecting a voltage of a test piece and an amplifier.

First, the half value period measurement device was connected to a synchroscope or a recording meter. The voltage applied was set to ± 10 kV, the distance from the tip end of the needle electrode of the application unit to the surface of the turntable was 20 mm, and the distance from the electrode of the receiving unit to the turntable was set to 15 mm. In the case where a test piece is extremely thick, the distance from the tip end of the needle of the application unit to the surface of the test piece and the distance from the electrode plate of the receiving unit thereto, should be set to 20 mm or 15 mm. Such conditions are added to the results.

Next, the test piece was discharged by means of a discharger, and then the test piece was mounted to a mount frame such that the surface thereof faces upwards. As the turntable was rotated, the application of a voltage of +10 kV was carried out for 30 seconds, and after that, the application of the voltage was stopped. Then, while the rotation of the turntable was maintained, the time required for which the charge

voltage decays to 1/2 of the initial charge voltage was measured. It should be noted that in the case where it takes 120 seconds or more for the initial charge voltage to attenuate to negative, the measurement was stopped at 120 seconds. For the rest of the four pieces, the measurement was carried out in the same manner. The result indicated that the charge property was 0V, and therefore the half value period was not observed.

10 (Example 5)

A flat plate was manufactured in the same manner as in Example 4, except that adipic acid-1,3-butyleneglycol was used as the main component of the plasticizer, 4,4'-butylene-bis-(3-methyl-6-t-butylphenol) was used as the main component of the anti-oxidizing agent, N,N'-bis-(diethyleneglycol) stearylamine was used as the main component of the antistatic agent, and 2-(2'-hydroxy-3',5'-di-t-amylphenyl)-5-chlorobenzotriazole was used as the main component of the ultraviolet ray absorbing agent.

The flat plate was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 4. As a result, the adsorption amount of wafer was as very small as 14 ng. Further, the peaks of the TIC were subjected to the quantitative analysis; however the peaks were so minute (the adsorption of organic material is very

small) that the quantitative analysis was not possible. Further, the charge voltage was 0V, and therefore the half value period was not observed.

(Example 6)

5 To 100 parts by weight of polyvinyl chloride resin
(having an average molecular weight of 20,000; a
product of MITSUI TOATSU KAGAKU), 25 parts by weight
of diisodecyl phthalate as a plasticizer, 1 part by
weight of 2,2'-methylene-bis-(4-methyl-6-t-butylphenyl)
10 as an anti-oxidizing agent, and 1 part by weight of
N,N'-bis-(diethyleneglycol) stearylamine were added,
and they were kneaded while heating. With use of this
material, the injection molding was carried out and
thus a flat plate was manufactured. In this case,
15 an ultraviolet absorbing agent, a sponging agent or
a sponging controlling agent was not added.

 The flat plate was examined in terms of the
organic material adsorption amount and charge property
of a wafer, as in the case of Example 4. As a result,
20 the adsorption amount of wafer was as very small as
20 ng. Further, the peaks of the TIC were subjected to
the quantitative analysis; however the peaks were so
minute (the adsorption of organic material is very
small) that the quantitative analysis was not possible.
25 Further, the charge voltage was 0V, and therefore the
half value period was not observed.

(Example 7)

To 100 parts by weight of polyvinyl chloride resin, 7 parts by weight of adipic acid-1,3-butyleneglycol and 10 parts by weight of trioctyl trimellitate were added as a plasticizer, 1 part by weight of 1,1,3-tris-(2-methyl-4-hydroxy-5-t-butylphenyl) butane was added as an anti-oxidizing agent, and 2 part by weight of glycerin fatty ester was added as an antistatic agent, and they were kneaded while heating. With use of this material, the injection molding was carried out and thus a flat plate was manufactured. In this case, an ultraviolet absorbing agent, a sponging agent or a sponging controlling agent was not added.

The flat plate was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 4. As a result, the adsorption amount of wafer was as very small as 16 ng. Further, the peaks of the TIC were subjected to the quantitative analysis; however the peaks were so minute (the adsorption of organic material is very small) that the quantitative analysis was not possible. Further, the charge voltage was 0V, and therefore the half value period was not observed.

(Comparative Example 3)

To 100 parts by weight of pre-polymer for polyurethane and a hardener, 5 parts by weight of dioctyl phthalate as a plasticizer, 2 parts by weight

of 2,6-di-t-butyl-p-cresol as an anti-oxidizing agent,
1.5 part by weight of N,N'-bis-(2-hydroxyethyl)
laurylamine as an anti-static agent, and 0.5 parts by
weight of 2,(2'-hydroxy-5'-methylphenyl) benzotriazol
5 as an ultraviolet ray absorbing agent were added, and
they were kneaded while heating. Further, to this
material, water serving as a sponging agent was added,
and dimethylpolysiloxane-polyoxyalkylene co-polymer
(having an average molecular weight of 1800; SHINETU
10 KAGAKU KOUGYOU) was further added as a sponging agent.
It should be noted that commercially available
dimethylpolysiloxane-polyoxyalkylene co-polymer was
used as it was. With use of this material, the
injection molding was carried out and thus a flat plate
15 was manufactured.

The flat plate was examined in terms of the
organic material adsorption amount and charge property
of a wafer, as in the case of Example 4. As a result,
the adsorption amount of wafer was as large as 285 ng.
20 Further, the peaks of the TIC were subjected to the
quantitative analysis, and dioctyl phthalate,
2,6-di-t-butyl-p-cresol, N,N'-bis-(2-hydroxyethyl)
laurylamine, 2,(2'-hydroxy-5'-methylphenyl)
benzotriazol, hexadecamethylcyclotrasiloxane,
25 octadecamethylcyclonanosiloxane and the like were
observed. Further, the charge voltage was 52V, and
therefore the half value period was 1.04 seconds or

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(Comparative Example 4)

To 100 parts by weight of polyvinyl chloride resin,
3 parts by weight of dioctyl phthalate as a plasticizer,
5 2 parts by weight of 2,6-di-t-butyl-p-cresol as an
anti-oxidizing agent, and 1.5 parts by weight of
N,N'-bis-(2-hydroxyethyl) laurylamide as an antistatic
agent were added, and they were kneaded while heating.
With use of this material, the injection molding was
10 carried out and thus a flat plate was manufactured.
In this case, an ultraviolet absorbing agent, a
sponging agent or a sponging controlling agent was not
added.

The flat plate was examined in terms of the
15 organic material adsorption amount and charge property
of a wafer, as in the case of Example 4. As a result,
the adsorption amount of wafer was as large as 300 ng.
Further, the peaks of the TIC were subjected to the
quantitative analysis, and dioctyl phthalate,
20 2,6-di-t-butyl-p-cresol, N,N'-bis-(2-hydroxyethyl)
laurylamide, and the like were observed.

7. Industrial Applicability

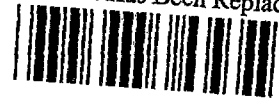
With regard to the wafer carrier, SMIF POD, wafer
box, wafer basket, wafer tray, wafer handling jig,
25 which are the instruments of the present invention,
the additives added to the resin base are of the types
which do not generate a gaseous organic material, and

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therefore the amount of the organic material components adsorbed to a wafer can be reduced to about 1/5 of the conventional case.

5 With regard to the wafer carrier, SMIF POD, wafer box, wafer basket, wafer tray, wafer handling jig, which are the instruments of the present invention, the additives added to the resin base are of the types which do not generate a gaseous organic material, and therefore the amount of the organic material components
10 adsorbed to a wafer can be reduced to about 1/5 of the conventional case.

15 Further, with regard to the shoe as a wearable article of the present invention, the additives added to the resin base which constitutes a sole are of the types which do not generate a gaseous organic material, and therefore the amount of the organic material components adsorbed to a wafer can be reduced to about 1/5 of the conventional case. Thus, the contamination of wafers with organic materials can be prevented in
20 the manufacture of a semiconductor device, and it becomes possible to improve the yield.

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C L A I M S

1. An instrument used for handing a substrate in a clean room at room temperature under atmosphere, comprising: a resin base and at least one of additives selected from the group consisting of a lubricant, a plasticizer, an anti-oxidizing agent and an antistatic agent, wherein the additives do not generate a gaseous organic material component under conditions of room temperature and atmospheric pressure.
2. An instrument according to claim 1, wherein the lubricant contains as a main component at least one selected from the group consisting of aliphatic hydrocarbons having a carbon atom number of 20 or more and higher alcohols having a carbon atom number of 18 or more, and does not contain aliphatic hydrocarbons having a carbon atom number of less than 20 and higher alcohols having a carbon atom number of less than 18.
3. An instrument according to claim 2, wherein the lubricant is made of at least one selected from the group consisting of microcrystalline wax, natural paraffin, synthetic paraffin, polyolefin wax, synthetic branch higher alcohols having a carbon atom number of 18, synthetic branch higher alcohols having a carbon atom number of 20, synthetic branch higher alcohols having a carbon atom number of 24 and oleyl alcohol.
4. An instrument according to claim 1, wherein the plasticizer contains as a main component at least

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one selected from the group consisting of carboxylic acid esters having a molecular weight of 400 or more, polyesters having a molecular weight of 400 or more and epoxy-based compounds having a molecular weight of 400 or more, and does not contain carboxylic acid esters having a molecular weight of less than 400, polyesters having a molecular weight of less than 400 and epoxy-based compounds having a molecular weight of less than 400.

10 5. An instrument according to claim 4, wherein the plasticizer is made of at least one selected from the group consisting of phthalic acid ester-based compounds, aliphatic dibasic acid ester-based compounds, trimellitate-based compounds, polyester-based compounds and epoxy-based compounds.

15 6. An instrument according to claim 1, wherein the anti-oxidizing agent is made of a phenol-based compound having a molecular weight of 300 or more.

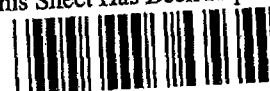
20 7. An instrument according to claim 6, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds, bisphenol-based compounds and high-molecular phenol-based compounds.

25 8. An instrument according to claim 1, wherein the antistatic agent is made of a nonion-based compound having a molecular weight of 350 or more.

 9. An instrument according to claim 8, wherein



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the nonion-based compound is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether,
5 polyoxyethylenealkylphenylether and N,N'-bis-(diethyleneglycol) stearylamine.

10 10. An instrument according to claim 1, wherein the instrument is a cassette, a SMIF POD, a wafer box, a wafer basket or a wafer handling jig, which is used for handing a semiconductor wafer.

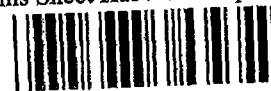
11. An instrument according to claim 1, wherein the resin base is made of one selected from the group consisting of a polyolefin, a polycarbonate and a fluorine resin.

15 12. A wearable article worn by an operator in a clean room at room temperature under atmosphere, comprising: a resin base and at least one of additives selected from the group consisting of a lubricant, a plasticizer, an anti-oxidizing agent and an antistatic
20 agent, wherein the additives do not generate a gaseous organic material component under conditions of room temperature and atmospheric pressure.

13. A wearable article according to claim 12, wherein the plasticizer contains as a main component
25 at least one selected from the group consisting of carboxylic acid esters having a molecular weight of 400 or more, polyesters having a molecular weight of 400 or



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more and epoxy-based compounds having a molecular weight of 400 or more, and does not contain carboxylic acid esters having a molecular weight of less than 400, polyesters having a molecular weight of less than 400
5 or epoxy-based compounds having a molecular weight of less than 400.

14. A wearable article according to claim 13, wherein the plasticizer is made of at least one selected from the group consisting of phthalic acid
10 ester-based compounds, aliphatic dibasic acid ester-based compounds, trimellitate-based compounds, polyester-based compounds and epoxy-based compounds.

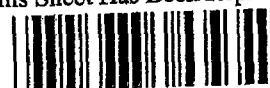
15. A wearable article according to claim 12, wherein the anti-oxidizing agent is made of a phenol-
15 based compound having a molecular weight of 300 or more.

16. A wearable article according to claim 15, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of
monophenol-based compounds, bisphenol-based
20 compounds and high-molecular phenol-based compounds.

17. A wearable article according to claim 12, wherein the antistatic agent is made of a nonion-based compound having a molecular weight of 350 or more.

18. A wearable article according to claim 17,
25 wherein the nonion-based compound is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide,





polyoxyethylenealkylether,
polyoxyethylenealkylphenylether and
N,N'-bis-(diethyleneglycol) stearylamine.

19. A wearable article according to claim 12,
5 wherein the ultraviolet ray absorbing agent is made of
a compound having a molecular weight of 300 or more.

20. A wearable article according to claim 19,
wherein the ultraviolet absorbing agent is made of
at least one selected from the group consisting of
10 salicylic acid-based compounds and benzophenon-based
compounds.

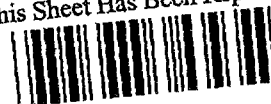
21. A wearable article according to claim 12,
wherein the resin base is polyvinyl chloride,
vinylchloride-based elastomer, chlorine-based
15 polyethylene or urethane resin.

22. A wearable article according to claim 12,
wherein the article is a shoe having a sole comprising
a prepolymer for urethane resin and a hardener, and
a material containing at least one of the additive
20 group consisting of a sponging agent for sponging the
urethane resin, a silicon-based sponging controlling
agent which does not substantially generate low-
molecular siloxane, a plasticizer, an anti-oxidizing
agent, an antistatic agent and an ultraviolet ray
25 absorbing agent.

23. A wearable article according to claim 22,
wherein the silicon-based sponging controlling agent is



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made of at least one selected from the group consisting of dimethylpolysiloxane which does not contain a cyclic siloxane having a silicon atom number of 10 or less, or dimethylpolysiloxane-polyoxyalkylene co-polymer.

- 5 24. A wearable article used in a clean room, comprising:

 a sole made of a urethane resin and at least one of additives selected from the group consisting of a sponging agent for sponging the urethane resin,
10 a silicon-based sponging controlling agent which does not substantially generate low-molecular siloxane, a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet ray absorbing agent; and

 a flexible cover adhered or stitched to the sole.

- 15 25. A wearable article according to claim 24, further comprising a fastener member for opening or closing the flexible cover.



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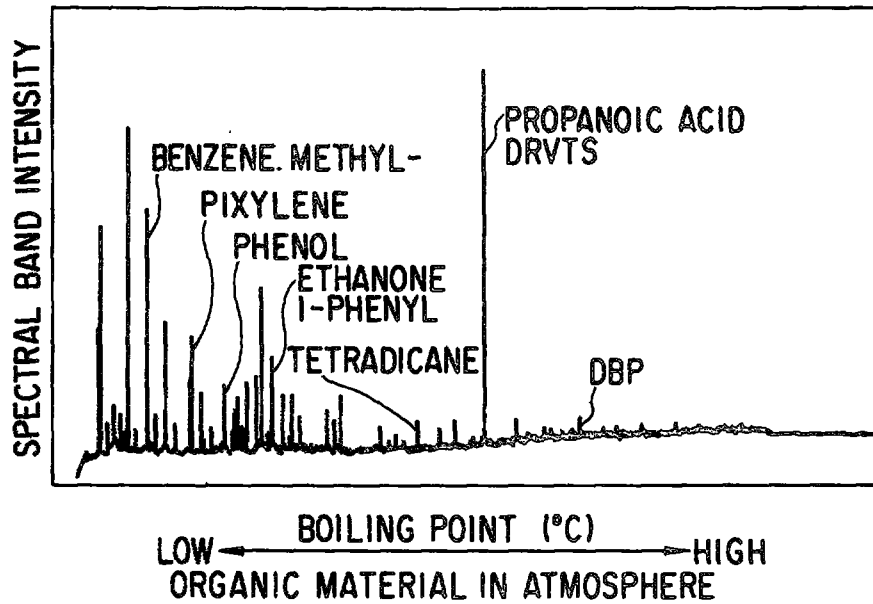
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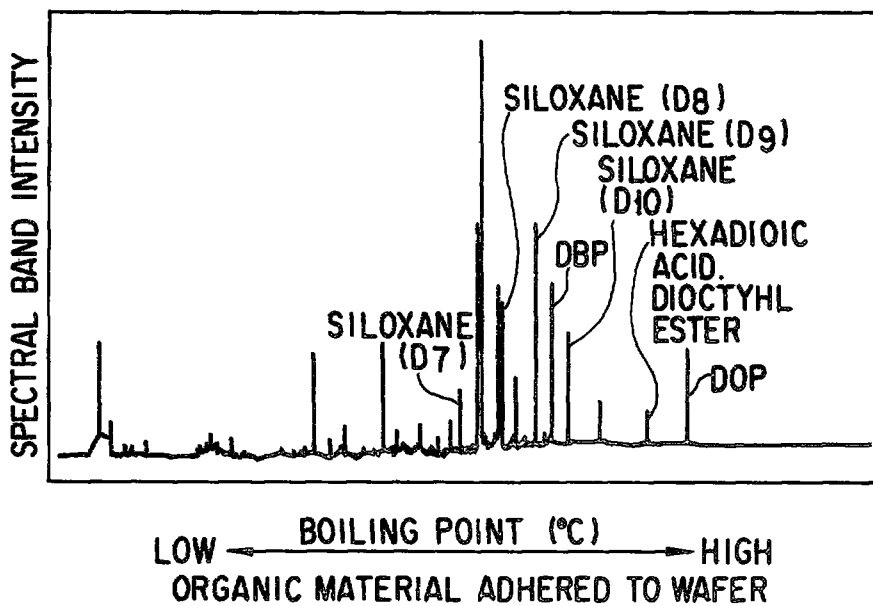
There are instruments used for handling
a substrate in a clean room at room temperature and
atmospheric pressure, which contain a resin base and at
5 least one additive selected from the group consisting
of a lubricant, a plasticizer, an anti-oxidizing agent
and an antistatic agent, and the additives do not
generate gaseous organic material compound under
conditions of room temperature and atmospheric pressure.

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F I G. 1 A



F I G. 1 B

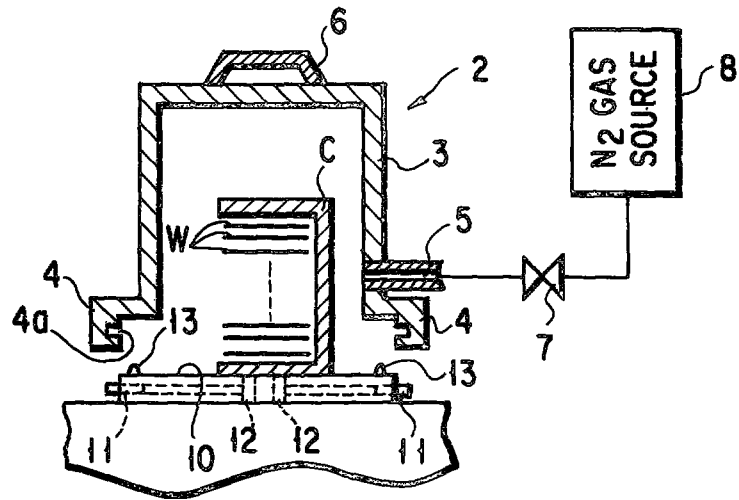


FIG. 2A

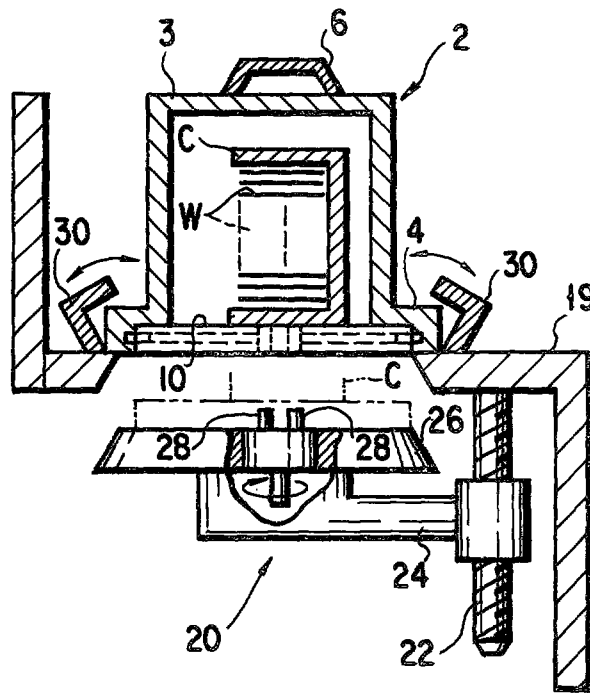


FIG. 2B

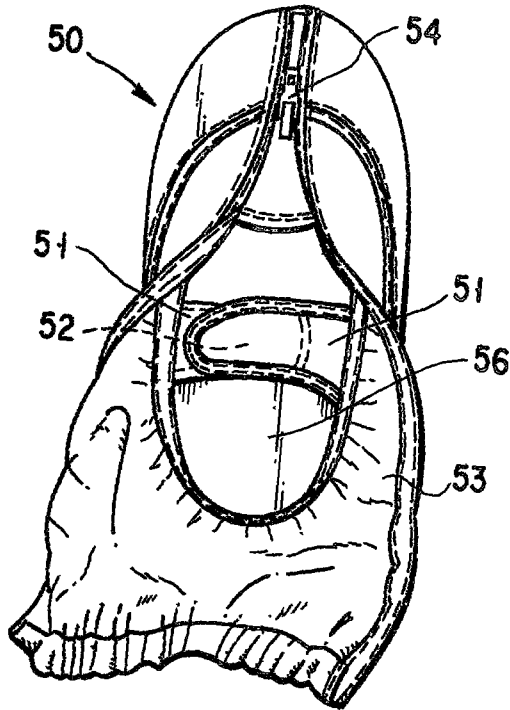


FIG. 3A

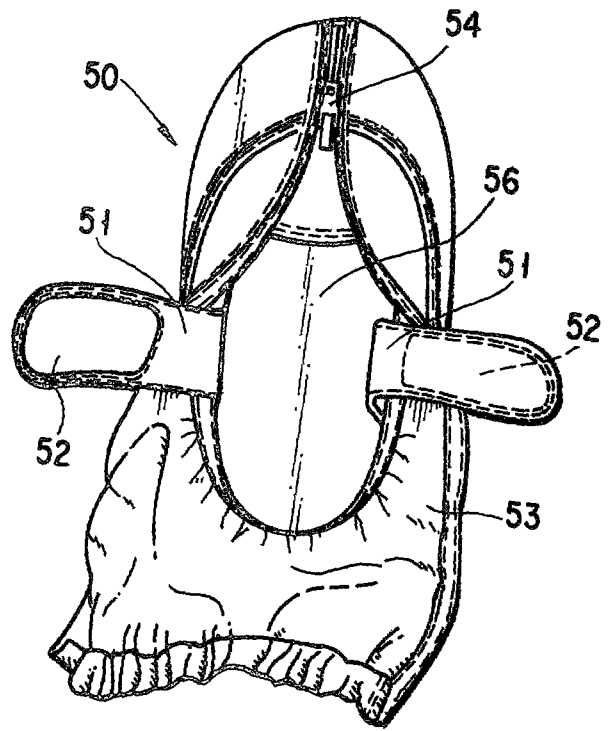
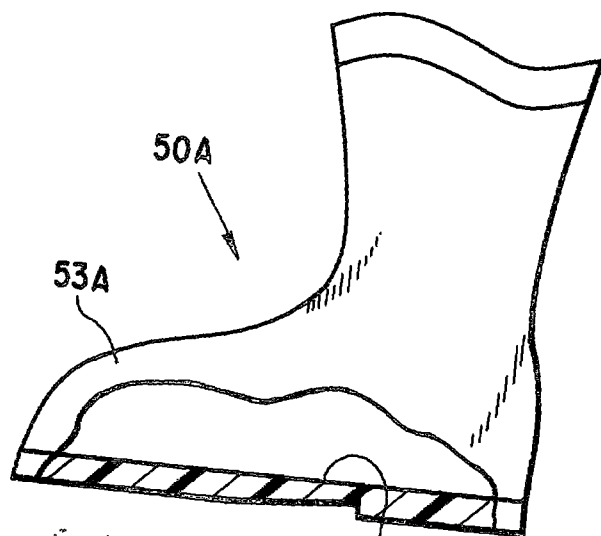


FIG. 3B

FIG. 4



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C L A I M S

1. (Amended) An instrument used for handling
a substrate in a clean room at room temperature under
5 atmosphere, comprising: a resin base; an anti-oxidizing
agent added to the resin base and an antistatic agent
added to the resin base, wherein the anti-oxidizing
agent and the antistatic agent do not generate a
gaseous organic material component under conditions of
10 room temperature and atmospheric pressure.

2. (Amended) An instrument according to claim 1,
wherein the resin base further comprises a lubricant,
and the lubricant contains as a main component at least
one selected from the group consisting of aliphatic
15 hydrocarbons having a carbon atom number of 20 or more
and higher alcohols having a carbon atom number of 18
or more, and does not contain aliphatic hydrocarbons
having a carbon atom number of less than 20 or higher
alcohols having a carbon atom number of less than 18.

20 3. (Amended) An instrument according to claim 2,
wherein the lubricant is made of at least one selected
from the group consisting of microcrystalline wax,
natural paraffin, synthetic paraffin, polyolefin wax,
synthetic branch higher alcohols having a carbon atom
25 number of 18 or more, synthetic branch higher alcohols
having a carbon atom number of 20 more, synthetic
branch higher alcohols having a carbon atom number of

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24 or more, and oleyl alcohol.

4. (Amended) An instrument according to claim 1, wherein the resin base further comprises a plasticizer, and the plasticizer contains as a main component at least one selected from the group consisting of carboxylic acid esters having a molecular weight of 400 or more, polyesters having a molecular weight of 400 or more and epoxy-based compounds having a molecular

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weight of 400 or more, and does not contain carboxylic acid esters having a molecular weight of less than 400, polyesters having a molecular weight of less than 400 or epoxy-based compounds having a molecular weight of less than 400.

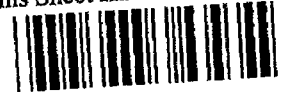
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5. An instrument according to claim 4, wherein the plasticizer is made of at least one selected from the group consisting of phthalic acid ester-based compounds, aliphatic dibasic acid ester-based compounds, trimellitate-based compounds, polyester-based compounds and epoxy-based compounds.

6. An instrument according to claim 1, wherein the anti-oxidizing agent is made of a phenol-based compound having a molecular weight of 300 or more.

7. An instrument according to claim 6, wherein the anti-oxidizing agent is made of one selected from the group consisting of monophenol-based compounds,





bisphenol-based compounds and high-molecular phenol-based compounds.

8. An instrument according to claim 1, wherein the antistatic agent is made of a nonion-based compound
5 having a molecular weight of 350 or more.

9. An instrument according to claim 8, wherein the nonion-based compound is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide,
10 polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N,N'-bis-(diethyleneglycol) stearylamine.

10. An instrument according to claim 1, wherein the instrument is a cassette, a SMIF POD, a wafer box,
15 a wafer basket or a wafer handling jig, which is used for handing a semiconductor wafer.

11. An instrument according to claim 1, wherein the resin base is made of one selected from the group consisting of a polyolefin, a polycarbonate and
20

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a fluorine resin.

12. (Amended) A wearable article worn by an operator in a clean room at room temperature under atmosphere, comprising: a resin base, an anti-oxidizing
25 agent added to the resin base, an antistatic agent added to the resin base and a plasticizer added to the resin base, wherein any of the anti-oxidizing agent,



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the antistatic agent and the plasticizer do not generate a gaseous organic material component under conditions of room temperature and atmospheric pressure.

13. A wearable article according to claim 12,
5 wherein the plasticizer contains as a main component at least one selected from the group consisting of carboxylic acid esters having a molecular weight of 400 or more, polyesters having a molecular weight of 400 or more and epoxy-based compounds having a molecular
10 weight of 400 or more, and does not contain carboxylic acid esters having a molecular weight of less than 400, polyesters having a molecular weight of less than 400 and epoxy-based compounds having a molecular weight of less than 400.

14. A wearable article according to claim 13,
15 wherein the plasticizer is made of at least one selected from the group consisting of phthalic acid ester-based compounds, aliphatic dibasic acid ester-based compounds, trimellitate-based compounds,
20 polyester-based compounds and epoxy-based compounds.

15. A wearable article according to claim 12,
wherein the anti-oxidizing agent is made of a phenol-based compound having a molecular weight of 300 or more.

16. A wearable article according to claim 15,

25

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wherein the anti-oxidizing agent is made of at least one selected from the group consisting of



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monophenol-based compounds, bisphenol-based compounds and high-molecular phenol-based compounds.

17. A wearable article according to claim 12, wherein the antistatic agent is made of a nonion-based compound having a molecular weight of 350 or more.

18. A wearable article according to claim 17, wherein the nonion-based compound is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N,N'-bis-(diethyleneglycol) stearylamine.

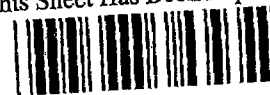
19. (Amended) A wearable article according to claim 12, further comprising an ultraviolet ray absorbing agent, wherein the ultraviolet ray absorbing agent is made of a compound having a molecular weight of 300 or more.

20. A wearable article according to claim 19, wherein the ultraviolet absorbing agent is made of at least one selected from the group consisting of salicylic acid-based compounds and benzophenon-based compounds.

21. A wearable article according to claim 12, wherein the resin base is polyvinyl chloride, vinylchloride-based elastomer, chlorine-based polyethylene or urethane resin.

22. A wearable article according to claim 12,





wherein the article is a shoe having a sole comprising a prepolymer for urethane resin and a hardener, and a material containing at least one of the additive

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5 group consisting of a sponging agent for sponging the urethane resin, a silicon-based sponging controlling agent which does not substantially generate low-molecular siloxane, a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet ray
10 absorbing agent.

23. A wearable article according to claim 22, wherein the silicon-based sponging controlling agent is made of at least one selected from the group consisting

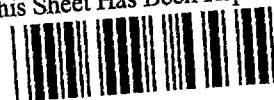
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15 of dimethylpolysiloxane which does not contain a cyclic siloxane having a silicon atom number of 10 or less, and dimethylpolysiloxane-polyoxyalkylene co-polymer.

24. A wearable article used in a clean room, comprising:

20 a sole made of an urethane resin and at least one of additives selected from the group consisting of a sponging agent for sponging the urethane resin, a silicon-based sponging controlling agent which does not substantially generate low-molecular siloxane,
25 a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet ray absorbing agent; and
a flexible cover adhered or stitched to the sole.





25. A wearable article according to claim 24, further comprising a fastener member for opening or closing the flexible cover.

26. (Added) An instrument used for handling a
5 substrate in a clean room at room temperature under atmosphere, comprising: a resin base; and at least one additive added to the resin base, selected from the group consisting of a lubricant, a plasticizer and an antistatic agent,

10 wherein the lubricant is made of a compound containing as a main component microcrystalline wax, natural paraffin, synthetic paraffin, polyolefin wax, synthetic branch higher alcohol having a carbon atom number of 18 or more, synthetic branch higher alcohol
15 having a carbon atom number of 20 or more, synthetic branch higher alcohol having a carbon atom number of 24 or more, and aleyl alcohol, and not containing aliphatic hydrocarbon having a carbon atom number of less than 20 and higher alcohol having a carbon atom
20 number of less than 18,

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the plasticizer is made of at least one compound having a molecular weight of 400 or more, selected from the group consisting of phthalic acid ester-based
25 compounds, aliphatic dibasic acid ester-based compounds, trimellitate-based compounds, polyester-based compounds and epoxy-based compounds, but not containing





carboxylic acid esters having a molecular weight of less than 400, polyesters having a molecular weight of less than 400 and epoxy-based compounds having a molecular weight of less than 400, and

- 5 the antistatic agent is made of a nonion-based compound having a molecular weight of 350 or more, which is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, 10 polyoxyethylenealkylphenylether and N,N'-bis-(diethyleneglycol) stearylamine,

wherein the additives do not generate a gaseous organic material compound under conditions of room temperature and atmospheric pressure.

- 15 27. (Added) An instrument according to claim 26, further comprising an anti-oxidizing agent, wherein the anti-oxidizing agent is made of a phenol-based compound having a molecular weight of 300 or more.

- 20 28. (Added) An instrument according to claim 27, further comprising an anti-oxidizing agent, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds, bis-phenol-based compounds and high molecular weight phenol-based compounds.

25

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29. (Added) A shoe worn by an operator in a clean room at room temperature under atmosphere, comprising:



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a resin base; and at least one additive added to the resin base, selected from the group consisting of a lubricant, a plasticizer and an antistatic agent,

5 wherein the lubricant is made of a compound containing as a main component microcrystalline wax, natural paraffin, synthetic paraffin, polyolefin wax, a synthetic branch higher alcohol having a carbon atom number of 18 or more, a synthetic branch higher alcohol having a carbon atom number of 20 or more, a synthetic
10 branch higher alcohol having a carbon atom number of 24 or more, and aleyl alcohol, and not containing aliphatic hydrocarbon having a carbon atom number of less than 20 and higher alcohol having a carbon atom number of less than 18,

15 the plasticizer is made of at least one compound having a molecular weight of 400 or more, selected from the group consisting of phthalic acid ester-based compounds, aliphatic dibasic acid ester-based compounds, trimellitate-based compounds, polyester-based compounds
20 and epoxy-based compounds, but not containing carboxylic acid esters having a molecular weight of less than 400, polyesters having a molecular weight of less than 400 and epoxy-based compounds having a molecular weight of less than 400, and

25 the antistatic agent is made of a nonion-based compound having a molecular weight of 350 or more, which is made of at least one selected from the group



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consisting of polyoxyethylenealkylamine,
polyoxyethylenealkylamide, polyoxyethylenealkylether,

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polyoxyethylenealkylphenylether and

5 N,N'-bis-(diethyleneglycol) stearylamine,

wherein the ultraviolet ray absorbing agent is
made of at least one compound having a molecular weight
of 300 or higher, selected from the group consisting of
salicylate-based compounds and benzo-phenone compounds,
10 and

the additives do not generate a gaseous organic
material compound under conditions of room temperature
and atmospheric pressure.

30. (Added) A shoe according to claim 29, further
15 comprising an anti-oxidizing agent, wherein the anti-
oxidizing agent is made of a phenol-based compound
having a molecular weight of 300 or more.

31. (Added) A shoe according to claim 30, further
comprising an anti-oxidizing agent, wherein the anti-
20 oxidizing agent is made of at least one selected from
the group consisting of monophenol-based compounds,
bis-phenol-based compounds and high molecular weight
phenol-based compounds.



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Further, examples of the instrument for handling substrates are a wafer box, SMIF POD, a wafer tray, a wafer cassette, a wafer basket and a wafer handling
5 jig. These wafer handling instruments are discussed in, for example, Jap. Pat. Appln. KOKAI Publication No. 1-222429 and U.S. Patent No. 4,534,389.

The inventors of the present invention examined organic materials in the atmosphere in the step of
10 manufacturing a semiconductor device, and obtained the results shown in FIG. 1A. Further, they examined organic materials adhered to a semiconductor wafer during the step of manufacturing a semiconductor device, and obtained the results shown in FIG. 1B. When these
15 results were taken as a whole, it was found that the detected organic materials match well the ordinary additives (lubricant, plasticizer, anti-oxidizing agent, antistatic agent) contained in the resin materials which constitute the instruments for handling
20 substrates, such as wafer cassettes and SMIF POD.

In consideration of the above findings, the inventors of the present invention have completed the present invention, and with use of additives (lubricant, plasticizer, anti-oxidizing agent and antistatic agent)
25 containing organic materials having boiling points higher than those organic materials (for example, a higher boiling point than that of DOP (dioctyl

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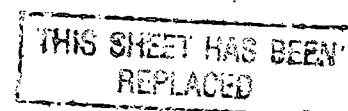
phthalate), that is, organic materials having low volatility values, the amount of organic material adsorbed onto a substrate can be significantly reduced. It should be noted that the judgment as to whether or not organic materials volatilize from a substrate handling instrument and are adsorbed on the surface of a substrate can be made by means of a wafer analyzer or the like, which will be explained later.

An instrument of the present invention, used in the clean room is an instrument used for handling a substrate in a clean room at room temperature and under atmospheric pressure, and it is characterized by including a resin base and at least one additive

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selected from the group consisting of an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, added to the resin base, and an antistatic agent made of a nonion-based compound having a molecular weight of 350 or more, added to the resin base, and that both the anti-oxidizing agent and antistatic agent do not easily generate a gaseous organic component from the resin base at room temperature and under atmospheric pressure.

When the molecular weight is 350 or more, the nonion-based antistatic agent is not released from the resin base at room temperature and under atmospheric pressure, as an out gas. Meanwhile, when the molecular





weight is 300 or more, the phenol-based antioxidizing agent is not released from the resin base at room temperature and under atmospheric pressure, as an out gas. In the case where a nonion-based antistatic agent and a phenol-based anti-oxidizing agent are co-present in a resin, H^+ group of the nonion-based antistatic agent and OH^- of the phenol-based anti-oxidizing group are attracted to each other to restrain each other, and therefore they are not substantially released from the resin base as an out gas.

Further, just in case where being released as an out gas and adsorbed on the surface of a substrate, the nonion-based antistatic agent causes a less adverse effect on the semiconductor device manufacturing process, and is substantially harmless, as compared to other anion-based or cation-based compounds. By contrast, in the case of some other type of an antistatic agent, for example, an anion-based antistatic agent, alkali metals such as Na and K contained in such an agent easily cause a short-circuiting of circuits or insulation error or the like. Thus, there is a great possibility that some critical adverse effect is caused on the semiconductor device. For this reason, it is not appropriate to use an anion-based antistatic agent in the manufacturing process of semiconductor devices these days. Or in the case where the antistatic agent is a cation-based compound,



- 11 -

chlorine ion, nitride ion, sulfide ion or the like
contained in the compound serve as a causing factor

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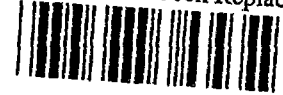
5 substance of corrosion. Therefore, it is not appropriate to use such an agent in the manufacturing process of semiconductor devices these days. As described, the nonion-based antistatic agent has an advantage that its is substantially harmless in the process of manufacturing semiconductor devices, as compared to some other
10 type of antistatic agent.

Page 5

The wearable articles of the present invention include shoes (of the type whose soles are covered by cloth), groves, clothes (suits), glasses and the like,
15 which are worn by the operator in a clean room during the manufacture of semiconductor devices. To these resin portion of the wearable articles, the plasticizer for enhancing the moldability and maintaining the material properties, the anti-oxidizing agent for
20 preventing the deterioration due to oxidization, which would occur during or after the molding process, and the antistatic agent for imparting an anti-static property, and if necessary, an ultraviolet ray absorbing agent, etct. Are added as additives.

25 The inventors of the present invention examined the organic components adhered to wafers during the manufacture of semiconductor devices, and it was found

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that they are components of the additives (plasticizer, anti-oxidizing agent, antistatic agent and ultraviolet ray absorbing agent) contained in the resin material which constitutes the sole of the shoe for clean room.

5 In consideration of the above findings, the inventors of the present invention have completed the

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present invention, and with use of additives (lubricant, plasticizer, anti-oxidizing agent, antistatic agent and
10 ultraviolet ray preventing agent) containing organic materials having boiling points higher than those organic materials (for example, a higher boiling point than that of 2,6-di-t-butyl-p-cresol), that is, organic materials having low volatility values (less generation
15 of out gas), the amount of organic material adsorbed onto a substrate can be significantly reduced. It should be noted that the judgment as to whether or not organic materials volatilize from the clean room shoe and are adsorbed on the surface of a substrate can be
20 made by means of a wafer analyzer or the like, which will be explained later.

A wearable article of the present invention, used in the clean room is an article worn by the operator in a clean room at room temperature and under atmospheric
25 pressure, and it is characterized by including a resin base and at least one additive selected from the group consisting of an anti-oxidizing agent made of



a phenol-based compound having a molecular weight of 300 or more, added to the resin base, an antistatic agent made of an nonion-based compound having a molecular weight of 350 or more, added to the resin base and a plasticizer added to the resin base, and that the anti-oxidizing agent, antistatic agent and plasticizer do not easily generate a gaseous organic component from the resin base at room temperature and under atmospheric pressure.

5. Brief Description of Drawings

FIG. 1A is a diagram showing a characteristic curve which indicates the measurement result of the organic materials contained in the atmosphere for processing semiconductor wafers (that is, clean room), and FIG. 1B is a diagram showing a characteristic curve which indicates the measurement result of the organic materials adhered to the surface of a semiconductor wafer;

FIG. 2A is a lateral cross sectional view showing a SMIF POD (Standard Mechanical Interface POD) used for isolating a wafer carrier (cassette) from outside atmosphere, and FIG. 2B is a lateral cross sectional view showing the SMIF POD, designed to illustrate the state of the SMIF POD in use;

FIGS. 3A and 3B are plan views showing a shoe for clean room; and

FIG. 4 is a side view of another shoe for clean



room.

6. Best Mode of Carrying Out the Invention

Various preferable modes of the present invention will now be specifically described.

5 First, while referring to FIGS. 2A and 2B, a SMIF

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POD (Standard Mechanical Interface POD) will now be described.

Jap. Pat. Appln. KOKAI Publication No. 1-222429
10 and U.S. Patent No. 4,534,389

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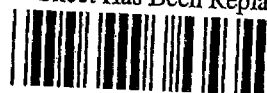
is sewn to matching edges of the flexible cover 53.

The fasteners 53 and 54 are designed to fasten up or open the flexible cover 53.

15 Further, the sole 56 is adhered or stitched to the other edge of the flexible cover 53. The sole 56 is made of an urethane resin, and a material containing at least one of the group consisting of additives such as a sponging agent for sponging the urethane resin,
20 a silicon-based sponging controlling agent which does not substantially generate siloxane of low molecular, a plasticizer, an anti-oxidizing agent, an anti-static agent and a UV ray absorbing agent. It should be noted that as shown in FIG. 4, there is another type of shoe
25 50A, in which a flexible cover 53A without a zip fastener is fixed onto a sole 56A.

In the case where the sole 56 of a clean room shoe

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is manufactured using the above-described resin base and additives, a predetermined amount of additive is added to a resin material, and kneaded while heating. Then, the resin composition is subjected to injection molding.

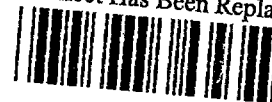
In the present invention, it is preferable that the main component of the plasticizer should be one of a calboxylate having a molecular weight of 420 or more, a polyester having a molecular weight of 400 or more, and an epoxy-based compound having a molecular weight of 400 or more. It is particularly preferable that the main component of the plasticizer should be at least one of phthalic acid ester-based compounds such as isodecyl phthalate (molecular weight: 447) and lauryl phthalate (molecular weight: 502); aliphatic dibasic acid ester-based compounds such as di-2-ethylhexyl azelate (molecular weight: 413) and di-2-ethylhexyl sebacate (molecular weight: 427); trimellitate ester-based compounds such as tris-2-ethylhexyl trimellitate

20

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(molecular weight: 547) and trioctyl trimellitate (molecular weight: 547); polyester-based compounds which are polymers obtained by reactions between dibasic acids such as adipic acid, azelaic acid, sebacic acid and phthalic acid, and glycol or glycerin, especially, propylene glycol adipate-based compounds or butylene glycol adipate-based compounds each having

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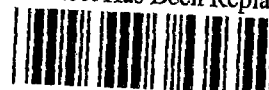
a molecular weight of 2000 to 8000; and epoxy-based compounds such as epoxy fatty ester-based compounds (molecular weight: 400 to 500) and epoxy oil (molecular weight: about 1000).

5 It should be noted that if the main component of the plasticizer is dibutyl phthalate (molecular weight: 278), dioctyl phthalate (molecular weight: 391) or di-2-ethylhexyl adipate (molecular weight: 371), having a molecular weight of less than 420, it volatilizes
10 from the sole of the shoe at a normal temperature of a clean room (23°C), and is adsorbed on a wafer. Therefore, it is not preferable.

 In the present invention, it is preferable that the main component of the anti-oxidizing agent should
15 be at least one of monophenol-based compounds such as stearyl- β -(3, 5-di-t-butyl-4-hydroxyphenyl) propionate (molecular weight: 520.9); bisphenol-based compounds such as 2,2'-methylene-bis-(4-methyl-6-t-butylphenol) (molecular weight: 340.5), 2,2'-methylene-bis-(4-ethyl-
20 6-t-butylphenol) (molecular weight: 368.5), 4,4'

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(having a molecular weight of 427; DAIHACHI KAGAKU KOGYO), 0.5 parts by weight of an anti-oxidizing agent (having a molecular weight of 340; YOSHITOMI SEIYAKU
25 KOGYO), 1 part by weight of an anti-static agent (having an average molecular of 450; LION), and 0.5 parts by weight of an ultraviolet ray absorbing

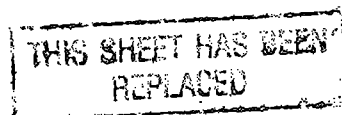


agent (having a molecular weight of 334; CHIBA
GAIGI CO.) were added, and they were kneaded while
heating. Further, to this material, water serving as
a sponging agent was added, and dimethylpolysiloxane-
5 polyoxyalkylene co-polymer (having an average molecular
weight of 1800; SHINETU KAGAKU KOUGYOU) was further
added as a sponging agent. It should be noted that the
commercially available sponging controlling agent was
not used for the instruments, wearable articles or
10 shoes of the present invention since it releases a
great amount of siloxane.

It should be further noted that dimethylpolysiloxane-
polyoxyalkylene co-polymer used here was treated at
a degree of vacuum of 10 mmHg at 150°C for 3 hours.
15 With use of this material, the injection molding was
carried out, and thus a flat plate having dimensions of
100 × 100 mm and a thickness of 10 mm was obtained.

In this case, the main component of the
plasticizer was di-2-ethylhexyl sebacate, the
20 main component of the anti-oxidizing agent was
2,2'-methylene-bis-(4-ethyl-6-t-butylphenol), the
main component of the antistatic agent was
polyethyleneglycol-p-nonylphenyl ether, and the main
component of the ultraviolet ray absorbing agent was
25 2-(2'-hydroxy-3',5'-di-t-amylphenol) benzotriazol.

A portion (40g) was cut out from the thus obtained
wafer carrier. With regard to the sample, organic





materials of the additives which were adsorbed on a wafer were examined using Silicon Wafer Analyzer (tradename, to be abbreviated as "SWA" hereinafter, product of GL Science).

5

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The SWA consists of roughly three devices, more specifically, a trap device for heat-desorbing adsorbed components from a wafer to which organic materials were adsorbed,

10

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was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 4. As a result, the adsorption amount of wafer was as large as 300 ng. Further, the peaks of the TIC were subjected to the quantitative analysis, and dioctyl phthalate, 2,6-di-t-butyl-p-cresol, N,N'-bis-(2-hydroxyethyl) laurylamide, and the like were observed.

15

7. Industrial Applicability

20

With regard to the wafer carrier, SMIF POD, wafer box, wafer basket, wafer tray, wafer handling jig, which are the instruments of the present invention, the additives added to the resin base are of the types which do not generate a gaseous organic material, and therefore the amount of the organic material components adsorbed to a wafer can be reduced to about 1/5 of the conventional case.

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With regard to the wafer carrier, SMIF POD, wafer box, wafer basket, wafer tray, wafer handling jig, which are the instruments of the present invention, the additives added to the resin base are of the types
5 which do not easily release a gaseous organic material at room temperature under atmospheric temperature, and therefore the amount of the organic material components adsorbed to a wafer can be reduced to about 1/5 of the conventional case.

10 Further, with regard to the shoe as a wearable article of the present invention, the additives added to the resin base which constitutes a sole are of the types which do not easily generate a gaseous organic material from the resin base at room temperature under
15 atmospheric pressure, and therefore the amount of the organic material components adsorbed to a wafer can be reduced to about 1/5 of the conventional case. Thus, the contamination of wafers with organic materials can be prevented in the manufacture of a semiconductor
20 device, and it becomes possible to improve the yield.

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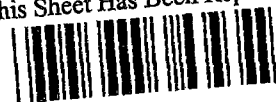
C L A I M S

1. (Amended) An instrument used for handling a
substrate in the manufacture of a semiconductor device
5 in a clean room at room temperature under atmosphere,
comprising: a resin base, an anti-oxidizing agent made
of a phenol-based compound having a molecular weight of
300 or more, and an antistatic agent made of a nonion-
based compound having a molecular weight of 350 or more,
10 wherein both the anti-oxidizing agent and antistatic
agent do not easily generate a gaseous organic material
component from the resin base under conditions of room
temperature and atmospheric pressure.

2. An instrument according to claim 1, wherein
15 the lubricant contains as a main component at least
one selected from the group consisting of aliphatic
hydrocarbons having a carbon atom number of 20 or more
and higher alcohols having a carbon atom number of 18
or more, and does not contain aliphatic hydrocarbons
20 having a carbon atom number of less than 20 and higher
alcohols having a carbon atom number of less than 18.

3. An instrument according to claim 2, wherein
the lubricant is made of at least one selected from
the group consisting of microcrystalline wax, natural
25 paraffin, synthetic paraffin, polyolefin wax, synthetic
branch higher alcohols having a carbon atom number of
18, synthetic branch higher alcohols having a carbon

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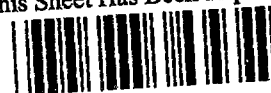
atom number of 20, synthetic branch higher alcohols having a carbon atom number of 24 and oleyl alcohol.

4. An instrument according to claim 1, wherein the resin base contains a plasticizer, and the plasticizer contains as a main component at least one

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- selected from the group consisting of diisodecyl phthalate having a molecular weight of 447 and dilauryl phthalate having a molecular weight of 502 as
- 10 carboxylic acid esters having a molecular weight of 420 or more, di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427, tris-2-ethylhexyl trimellate having a molecular weight of 547, trioctyl trimellite
- 15 having a molecular weight of 547, propyleneglycol adipate having a molecular weight of 2000 to 8000 as polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound having a molecular weight of 400 to 500 as epoxy-based compound
- 20 having a molecular weight of 400 or more, and epoxydized oil having a molecular weight of 1000 or more, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based
- 25 compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil





having a molecular weight of less than 1000.

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5. (Deleted)

6. (Deleted)

5 7. (Amended) An instrument according to claim 1,
wherein the anti-oxidizing agent is made of at least
one selected from the group consisting of monophenol-
based compounds, bisphenol-based compounds and
high-molecular phenol-based compounds.

10 8. (Deleted)

9. (Amended) An instrument according to claim 1,
wherein the nonion-based compound serving as the
antistatic agent is made of at least one selected from
the group consisting of polyoxyethylenealkylamine,
15 polyoxyethylenealkylamide, polyoxyethylenealkylether,
polyoxyethylenealkylphenylether and
N,N'-bis-(diethyleneglycol) stearylamine.

10. (Amended) An instrument according to claim 1,
wherein the instrument is a cassette, a SMIF POD,
20 a wafer tray, a wafer box, a wafer basket or a wafer
handling jig, which is used for handing a semiconductor
wafer.

11. An instrument according to claim 1, wherein
the

25

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resin base is made of one selected from the group
consisting of a polyolefin, a polycarbonate and



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a fluorine resin.

12. (Amended) A wearable article worn by an operator in a clean room at room temperature under atmosphere, comprising: a resin base and an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, an antistatic agent made of a nonion-based compound having a molecular weight of 350 or more, and a plasticizer added to the resin base, wherein all of the anti-oxidizing agent, antistatic agent and the plasticizer do not easily generate a gaseous organic material component from the resin base under conditions of room temperature and atmospheric pressure.

13. (Amended) A wearable article according to claim 12, wherein the plasticizer contains as a main component, at least one selected from the group consisting of diisodecyl phthalate having a molecular weight of 447 and dilauryl phthalate having a molecular weight of 502, di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427 as carboxylic acid esters having a molecular weight of 420 or more, tris-2-ethylhexyl trimellate having a molecular weight of 547, trioctyl trimellite having a molecular weight of 547, propyleneglycol adipate having a molecular weight of 2000 to 8000 as polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound





having a molecular weight of 400 to 500 as epoxy-based compound having a molecular weight of 400 or more, and epoxydized oil having a molecular weight of 1000 or more, and does not contain carboxylic acid esters

5 having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil

10

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having a molecular weight of less than 1000.

14. (Deleted)

15. (Deleted)

15 16. (Amended) A wearable article according to claim 12, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds,

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20 bisphenol-based compounds and high-molecular phenol-based compounds.

17. (Deleted)

25 18. (Amended) A wearable article according to claim 12, wherein the nonion-based compound serving as the antistatic agent is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether and



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N,N'-bis-(diethyleneglycol) stearylamine.

19. (Deleted)

20. (Amended) A wearable article according to
claim 12, further comprising an ultraviolet absorbing
5 agent, and the ultraviolet absorbing agent is made of
a compound having a molecular weight of 300 or more
containing at least one selected from the group
consisting of salicylic acid-based compounds and
benzophenon-based compounds.

10 21. A wearable article according to claim 12,
wherein the resin base is polyvinyl chloride,
vinylchloride-based elastomer, chlorine-based
polyethylene or urethane resin.

22. (Amended) A wearable article according to
15 claim 12, wherein the article is a shoe having a sole
comprising a prepolymer for urethane resin and a
hardener, and a material containing at least one of
the additive group consisting of a sponging agent for

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20 sponging the urethane resin, a silicon-based sponging
controlling agent subjected to a vacuum heat process
such that the agent does not substantially generate
low-molecular siloxane, a plasticizer, an anti-
oxidizing agent, an antistatic agent and an ultraviolet
25 ray absorbing agent.

23. (Amended) A wearable article according to
claim 22, wherein the silicon-based sponging





controlling agent is made of at least one selected from the group consisting

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of dimethylpolysiloxane which does not contain a cyclic
5 siloxane having a silicon atom number of 10 or less, or
dimethylpolysiloxane-polyoxyalkylene co-polymer.

24. (Amended) A wearable article used in a clean room, comprising:

a sole made of a urethane resin and at least one
10 of additives selected from the group consisting of
a sponging agent for sponging the urethane resin,
a sponging agent for sponging the urethane resin,
a silicon-based sponging controlling agent subjected
to vacuum heat process such that the agent does not
15 substantially generate cyclic siloxane having a silicon
atom number of 10 or less, a plasticizer, an anti-
oxidizing agent, an antistatic agent and an ultraviolet
ray absorbing agent; and

a flexible cover adhered or stitched to the sole.

20 25. A wearable article according to claim 24,
further comprising a fastener member for opening or
closing the flexible cover.

26. (Deleted)

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25 27. (Deleted)

28. (Deleted)

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29. (Amended) A shoe worn by an operator in a clean room at room temperature and under atmospheric pressure, comprising: a resin base, and at least one additive selected from the group consisting of a
5 lubricant, a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet ray absorbing agent, wherein the lubricant contains as a main component a compound made of at least one selected from the group consisting of microcrystalline wax, natural paraffin,
10 synthetic paraffin, polyolefin wax, synthetic branch higher alcohols having a carbon atom number of 18 or more, synthetic branch higher alcohols having a carbon atom number of 20 or more, synthetic branch higher alcohols having a carbon atom number of 24 or more
15 and oleyl alcohol, and not containing aliphatic hydrocarbons having a carbon atom number of less than 20 or higher alcohols having a carbon atom number of less than 18,

the plasticizer is made of a compound which
20 contains as a main component one selected from the group consisting of diisodecyl phthalate having a molecular weight of 447 and dilauryl phthalate having a molecular weight of 502 as carboxylic acid esters having a molecular weight of 420 or more,
25 di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427, as carbolic acid diesters having a molecular





weight of 420 or more, tris-2-ethylhexyl trimellate
having a molecular weight of 547, trioctyl trimellite
having a molecular weight of 547, propyleneglycol
adipate having a molecular weight of 2000 to 8000 as
5 polyesters having a molecular weight of 400 or more,
epoxy fatty acid ester-based compound having a
molecular weight of 400 to 500 as epoxy-based compound
having a molecular weight of 400 or more, and
epoxydized oil having a molecular weight of 1000 or
10 more, and does not contain carboxylic acid esters
having a molecular weight of less than 420, polyesters
having a molecular weight of less than 400, epoxy-based
compounds having a molecular weight of less than 400,
epoxy fatty acid ester-based compound having a
15 molecular weight of less than 400 or epoxidized oil
having a molecular weight of less than 1000, and does
not contain carboxylic acid esters having a molecular
weight of less than 420, polyesters having a molecular

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20 weight of less than 400, epoxy-based compounds having a
molecular weight of less than 400, epoxy fatty acid
ester-based compound having a molecular weight of less
than 400 or epoxidized oil having a molecular weight of
less than 1000,

25 the antioxidizing agent is made of a phenol-based
compound having a molecular weight of 300 or more,

the antistatic agent is made of a nonion-based



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compound having a molecular weight of 350 or more
containing at least one selected from the group
consisting of polyoxyethylenealkylamine,
polyoxyethylenealkylamide, polyoxyethylenealkylether,
5 polyoxyethylenealkylphenylether and
N,N'-bis-(diethyleneglycol) stearylamine, and

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the ultraviolet ray absorbing agent is made of
a compound having a molecular weight of 300 or more,
10 selected from the group consisting of salicylic acid-
based compounds and benzophenone-based compounds,

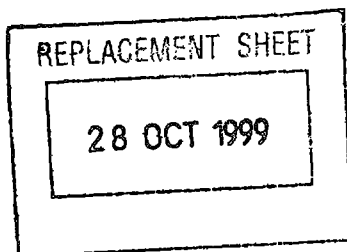
wherein the additives do not easily release a
gaseous organic material component from the resin base
at room temperature and under atmospheric pressure.

15 30. (Deleted)

31. (Amended) A shoe according to claim 29,
wherein the anti-oxidizing agent is made of at least
one selected from the group consisting of monophenol-
based compounds, bisphenol-based compounds and
20 high-molecular phenol-based compounds.

32. (Added) A wearable article according to
claim 24, further comprising a lubricant, the lubricant
containing a main component a compound made of at least
one selected from the group consisting of
25 microcrystalline wax, natural paraffin, synthetic
paraffin and polyolefin wax, but not containing
alcohols.





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CLAIMS

1. An instrument used for handling a substrate in the manufacture of a semiconductor device in a clean room at room temperature under atmosphere, comprising: a resin base, an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, and an antistatic agent made of a nonion-based compound having a molecular weight of 350 or more, wherein both the anti-oxidizing agent and antistatic agent do not easily generate a gaseous organic material component from the resin base under conditions of room temperature and atmospheric pressure.

2. An instrument according to claim 1, wherein the lubricant contains as a main component at least one selected from the group consisting of aliphatic hydrocarbons having a carbon atom number of 20 or more and higher alcohols having a carbon atom number of 18 or more, and does not contain aliphatic hydrocarbons having a carbon atom number of less than 20 and higher alcohols having a carbon atom number of less than 18.

3. An instrument according to claim 2, wherein the lubricant is made of at least one selected from the group consisting of microcrystalline wax, natural paraffin, synthetic paraffin, polyolefin wax, synthetic branch higher alcohols having a carbon atom number of 18, synthetic branch higher alcohols having a carbon atom number of 20, synthetic branch higher alcohols having a carbon atom number of 24 and oleyl alcohol.

4. An instrument according to claim 1, wherein the resin base contains a plasticizer, and the plasticizer contains as a main component at least



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- one selected from the group consisting of diisodecyl phthalate having a molecular weight of 447 and dilauryl phthalate having a molecular weight of 502 as carboxylic acid esters having a molecular weight of 420 or more,
- 5 di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427, tris-2-ethylhexyl trimellate having a molecular weight of 547, trioctyl trimellite having a molecular weight of 547, propyleneglycol adipate having a molecular weight of 2000 to 8000 as
- 10 polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound having a molecular weight of 400 to 500 as epoxy-based compound having a molecular weight of 400 or more, and epoxydized oil having a molecular weight of 1000 or more, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of
- 15 less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil having a molecular weight of less than 1000.

5. An instrument according to claim 1, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of
- 20 monophenol-based compounds, bisphenol-based compounds and high-molecular phenol-based compounds.

6. An instrument according to claim 1, wherein the nonion-based compound serving as the antistatic agent is made of at least one selected from



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the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N,N'-bis-(diethyleneglycol) stearylamine.

5 7. An instrument according to claim 1, wherein the instrument is a cassette, a SMIF POD, a wafer tray, a wafer box, a wafer basket or a wafer handling jig, which is used for handing a semiconductor wafer.

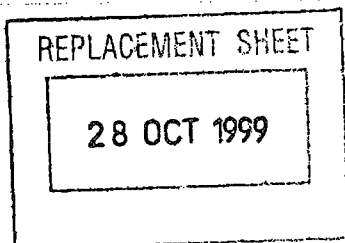
8. An instrument according to claim 1, wherein the resin base is made of one selected from the group consisting of a polyolefin, a polycarbonate
10 and a fluorine resin.

9. A wearable article worn by an operator in a clean room at room temperature under atmosphere, comprising: a resin base and an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, an antistatic agent made of a nonion-based compound having a
15 molecular weight of 350 or more, and a plasticizer added to the resin base, wherein all of the anti-oxidizing agent, antistatic agent and the plasticizer do not easily generate a gaseous organic material component from the resin base under conditions of room temperature and atmospheric pressure.

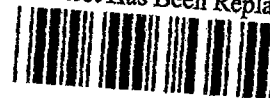
10. A wearable article according to claim 9, wherein the plasticizer
20 contains as a main component, at least one selected from the group consisting of diisodecyl phthalate having a molecular weight of 447 and dilauryl phthalate having a molecular weight of 502, di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427 as carboxylic acid esters having a molecular weight of 420 or more, tris-2-
25 ethylhexyl trimellate having a molecular weight of 547, trioctyl trimellite having a



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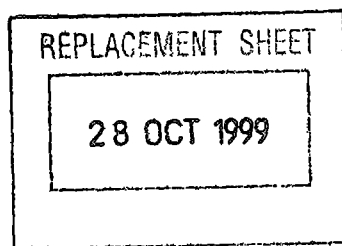
molecular weight of 547 propyleneglycol adipate having a molecular weight of 2000 to 8000 as polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound having a molecular weight of 400 to 500 as
5 epoxy-based compound having a molecular weight of 400 or more, and epoxydized oil having a molecular weight of 1000 or more, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound
10 having a molecular weight of less than 400 or epoxidized oil having a molecular weight of less than 1000.

11. A wearable article according to claim 9, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds, bisphenol-based compounds and high-
15 molecular phenol-based compounds.

12. A wearable article according to claim 9, wherein the nonion-based compound serving as the antistatic agent is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N,N'-bis-
20 (diethyleneglycol) stearylamine.

13. A wearable article according to claim 9, further comprising an ultraviolet absorbing agent, and the ultraviolet absorbing agent is made of a compound having a molecular weight of 300 or more containing at least one selected from the group consisting of salicylic acid-based compounds and
25 benzophenon-based compounds.





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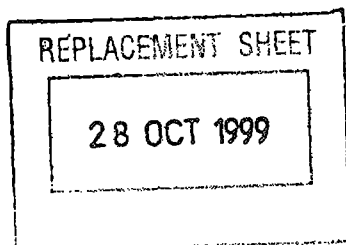
14. A wearable article according to claim 9, wherein the resin base is polyvinyl chloride, vinylchloride-based elastomer, chlorine-based polyethylene or urethane resin.

5 15. A wearable article according to claim 9, wherein the article is a shoe having a sole comprising a prepolymer for urethane resin and a hardener, and a material containing at least one of the additive group consisting of a sponging agent for sponging the urethane resin, a silicon-based sponging controlling agent subjected to a vacuum heat process such that the agent does
10 not substantially generate low-molecular siloxane, a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet ray absorbing agent.

16. A wearable article according to claim 15, wherein the silicon-based sponging controlling agent is made of at least one selected from the group consisting of dimethylpolysiloxane which does not contain a cyclic
15 siloxane having a silicon atom number of 10 or less, or dimethylpolysiloxane-polyoxyalkylene co-polymer.

17. A wearable article used in a clean room, comprising:
a sole made of a urethane resin and at least one of additives selected from the group consisting of
20 a sponging agent for sponging the urethane resin,
a sponging agent for sponging the urethane resin,
a silicon-based sponging controlling agent subjected to vacuum heat process such that the agent does not substantially generate cyclic siloxane having a silicon atom number of 10 or less, a plasticizer, an anti-oxidizing agent, an
25 antistatic agent and an ultraviolet ray absorbing agent; and





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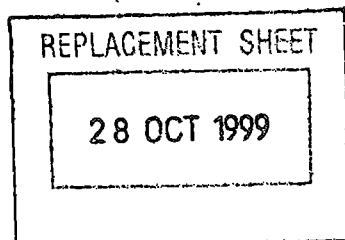
a flexible cover adhered or stitched to the sole.

18. A wearable article according to claim 17, further comprising a fastener member for opening or closing the flexible cover.

5 19. A shoe worn by an operator in a clean room at room temperature and under atmospheric pressure, comprising: a resin base, and at least one additive selected from the group consisting of a lubricant, a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet ray absorbing agent, wherein the lubricant contains as a main component a compound made of at
10 least one selected from the group consisting of microcrystalline wax, natural paraffin, synthetic paraffin, polyolefin wax, synthetic branch higher alcohols having a carbon atom number of 18 or more, synthetic branch higher alcohols having a carbon atom number of 20 or more, synthetic branch higher alcohols having a carbon atom number of 24 or more and oleyl alcohol, and not
15 containing aliphatic hydrocarbons having a carbon atom number of less than 20 or higher alcohols having a carbon atom number of less than 18,

the plasticizer is made of a compound which contains as a main component one selected from the group consisting of diisodecyl phthalate having a molecular weight of 447 and dilauryl phthalate having a molecular
20 weight of 502 as carboxylic acid esters having a molecular weight of 420 or more, di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427, as carboxylic acid diesters having a molecular weight of 420 or more, tris-2-ethylhexyl trimellate having a molecular weight of 547, trioctyl trimellite having a molecular weight of 547,
25 propyleneglycol adipate having a molecular weight of 2000 to 8000 as





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polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound having a molecular weight of 400 to 500 as epoxy-based compound having a molecular weight of 400 or more, and epoxydized oil having
5 a molecular weight of 1000 or more, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil having a molecular weight of less than
10 1000, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil having a molecular weight of less than 1000,

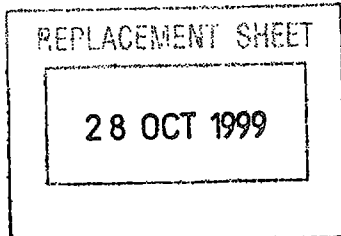
15 the antioxidizing agent is made of a phenol-based compound having a molecular weight of 300 or more,

the antistatic agent is made of a nonion-based compound having a molecular weight of 350 or more containing at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide,
20 polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N,N'-bis-(diethyleneglycol) stearylamine, and

the ultraviolet ray absorbing agent is made of a compound having a molecular weight of 300 or more, selected from the group consisting of salicylic acid-based compounds and benzophenone-based compounds,

25





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wherein the additives do not easily release a gaseous organic material component from the resin base at room temperature and under atmospheric pressure.

5 20. A shoe according to claim 19, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds, bisphenol-based compounds and high-molecular phenol-based compounds.

21. A wearable article according to claim 17, further comprising a
10 lubricant, the lubricant containing a main component a compound made of at least one selected from the group consisting of microcrystalline wax, natural paraffin, synthetic paraffin and polyolefin wax, but not containing alcohols.

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a substrate can be made by means of a wafer analyzer or the like, which will be explained later.

In the present invention, a "substrate" is meant to be an object of the manufacture of semiconductor devices, such as a silicon wafer, glass substrate or mask. Further, examples of the instrument for handling substrates are a wafer box, SMIF POD, a wafer tray, a wafer cassette, a wafer basket and a wafer handling jig. These wafer handling instruments are discussed in, for example, Jap. Pat. Appln. KOKAI Publication No. 1-222429 and U.S. Patent No. 4,534,389.

The inventors of the present invention examined organic materials in the atmosphere in the step of manufacturing a semiconductor device, and obtained the results shown in FIG. 1A. Further, they examined organic materials adhered to a semiconductor wafer during the step of manufacturing a semiconductor device, and obtained the results shown in FIG. 1B. When these results were taken as a whole, it was found that the detected organic materials match well the ordinary additives (lubricant, plasticizer, anti-oxidizing agent, antistatic agent) contained in the resin materials which constitute the instruments for handling substrates, such as wafer cassettes and SMIF POD.

In consideration of the above findings, the inventors of the present invention have completed the present invention, and with use of additives (lubricant, plasticizer, anti-oxidizing agent and antistatic agent) containing organic materials having boiling points higher than those organic materials (for example, a higher boiling point than that of DOP (dioctyl phthalate), that is, organic materials having low volatility values, the amount of organic material adsorbed onto a substrate can be significantly reduced. It should be noted that

REPLACEMENT SHEET

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the judgment as to whether or not organic materials volatilize from a substrate handling instrument and are adsorbed on the surface of a substrate can be made by means of a wafer analyzer or the like, which will be explained later.

An instrument of the present invention, used in the clean room is an
5 instrument used for handling a substrate in a clean room at room temperature and under atmospheric pressure, and it is characterized by including a resin base and at least one additive selected from the group consisting of an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, added to the resin base, and an antistatic agent made of an
10 nonion-based compound having a molecular weight of 350 or more, added to the resin base, and that both the anti-oxidizing agent and antistatic agent do not easily generate a gaseous organic component from the resin base at room temperature and under atmospheric pressure.

When the molecular weight is 350 or more, the nonion-based antistatic
15 agent is not released from the resin base at room temperature and under atmospheric pressure, as an out gas. Meanwhile, when the molecular weight is 300 or more, the phenol-based anti-oxidizing agent is not released from the resin base at room temperature and under atmospheric pressure, as an out gas. In the case where a nonion-based antistatic agent and a phenol-based
20 anti-oxidizing agent are co-present in a resin, H^+ group of the nonion-based antistatic agent and OH^- of the phenol-based anti-oxidizing group are attracted to each other to restrain each other, and therefore they are not substantially released from the resin base as an out gas.

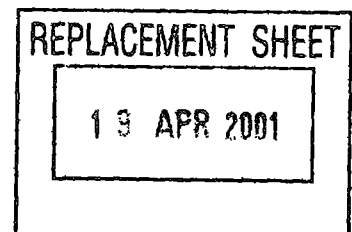
Further, just in case where being released as an out gas and adsorbed
25 on the surface of a substrate, the nonion-based antistatic agent causes a less

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adverse effect on the semiconductor device manufacturing process, and is substantially harmless, as compared to other anion-based or cation-based compounds. By contrast, in the case of some other type of an antistatic agent, for example, an anion-based antistatic agent, alkali metals such as Na and K
5 contained in such an agent easily cause a short-circuiting of circuits or insulation error or the like. Thus, there is a great possibility that some critical adverse effect is caused on the semiconductor device. For this reason, it is not appropriate to use an anion-based antistatic agent in the manufacturing process of semiconductor devices these days. Or in the case where the antistatic agent
10 is a cation-based compound, chlorine ion, nitride ion, sulfide ion or the like contained in the compound serve as a causing factor substance of corrosion. Therefore, it is not appropriate to use such an agent in the manufacturing process of semiconductor devices these days. As described, the nonion-based antistatic agent has an advantage that it is substantially harmless in the process
15 of manufacturing semiconductor devices, as compared to some other type of antistatic agent.

The wearable articles of the present invention include shoes (of the type whose soles are covered by cloth), groves, clothes (suits), glasses and the like, which are worn by the operator in a clean room during the manufacture of
20 semiconductor devices. To these resin portion of the wearable articles, the plasticizer for enhancing the moldability and maintaining the material properties, the anti-oxidizing agent for preventing the deterioration due to oxidization, which would occur during or after the molding process, and the antistatic agent for imparting an anti-static property, and if necessary, an ultraviolet ray absorbing
25 agent, etc. are added as additives.



The inventors of the present invention examined the organic components adhered to wafers during the manufacture of semiconductor devices, and it was found that they are components of the additives (plasticizer, anti-oxidizing agent, antistatic agent and ultraviolet ray absorbing agent) contained in the
5 resin material which constitutes the sole of the shoe for clean room.

In consideration of the above findings, the inventors of the present invention have completed the present invention, and with use of additives (lubricant, plasticizer, anti-oxidizing agent, antistatic agent and ultraviolet ray preventing agent) containing organic materials having boiling points higher than
10 those organic materials (for example, a higher boiling point than that of 2, 6-di-t-butyl-p-cresol), that is, organic materials having low volatility values (less generation of out gas), the amount of organic material adsorbed onto a substrate can be significantly reduced. It should be noted that the judgment as whether or not organic materials volatilize from the clean room shoe and are adsorbed
15 on the surface of a substrate can be made by means of a wafer analyzer or the like, which will be explained later.

A wearable article of the present invention, used in the clean room is an article worn by the operator in a clean room at room temperature and under atmospheric pressure, and it is characterized by including a resin base and at
20 least one additive selected from the group consisting of an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, added to the resin base, an antistatic agent made of a nonion-based compound having a molecular weight of 350 or more, added to the resin base and a plasticizer added to the resin base, and that the anti-oxidizing agent,
25 antistatic agent and plasticizer do not easily generate a gaseous organic

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component from the resin base at room temperature and under atmospheric pressure.

5. Brief Description of Drawings

FIG. 1A is a diagram showing a characteristic curve which indicates the measurement result of the organic materials contained in the atmosphere for processing semiconductor wafers (that is, clean room), and FIG. 1B is a diagram showing a characteristic curve which indicates the measurement result of the organic materials adhered to the surface of a semiconductor wafer;

FIG. 2A is a lateral cross sectional view showing a SMIF POD (Standard Mechanical Interface POD) used for isolating a wafer carrier (cassette) from outside atmosphere, and FIG. 2B is a lateral cross sectional view showing the SMIF POD, designed to illustrate the state of the SMIF POD in use;

FIGS. 3A and 3B are plan views showing a shoe for clean room; and

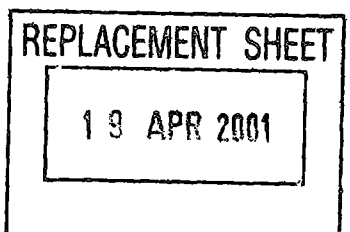
FIG. 4 is a side view of another shoe for clean room.

15 6. Best Mode of Carrying Out the Invention

Various preferable modes of the present invention will now be specifically described.

First, while referring to FIGS. 2A and 2B, a SMIF POD (Standard Mechanical Interface POD) will now be described.

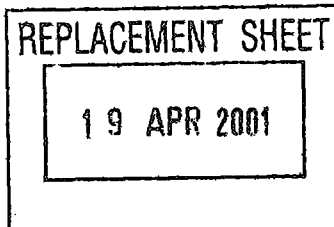
20 Jap. Pat. Appln. KOKAI Publication No. 1-222429 and U.S. Patent No. 4,534,389 each discloses a portable SMIF POD 2 used for isolating a wafer W and a carrier (cassette) C from outside atmosphere. As can be seen in FIG. 2A, the SMIF POD 2 includes a box-shaped cover 3 and a disk-shaped bottom portion 10. The SMIF POD cover 3 is an integral molded form of a transparent



9a

or semitransparent resin, which has a volume sufficient to contain one wafer cassette C, and at the uppermost portion thereof, a handle 6 is provided.

In a lower section of the SMIF POD cover 3, a flange portion 4 is formed. Further, a ring-like recess section 4a is made in an inner side of the flange
5 portion 4. The bottom portion 10 of the SMIF POD has a plurality of pins 11. Each of the pins 11 is



reference to FIGS. 3A and 3B and FIG. 4.

A shoe for clean room is disclosed in Jpn. Pat. Appln. KOKAI Publication No. 7-297257. As shown in FIGS. 3A and 3B, a shoe 50 for a clean room includes a pair of flexible tab members 51, velcro fasteners 52, a flexible cover 53, an ordinary fastener 54 and a sole 56. The velcro fasteners 52 are adhered, one to the front surface of one of the tab members 51 and the other to the rear surface of the other tab member 51. The ordinary fastener 54 is sewn to matching edges of the flexible cover 53. The fasteners 53 and 54 are designed to fasten up or open the flexible cover 53.

Further, the sole 56 is adhered or stitched to the other edge of the flexible cover 53. The sole 56 is made of an urethane resin, and a material containing at least one of the group consisting of additives such as a sponging agent for sponging the urethane resin, a silicon-based sponging controlling agent which does not substantially generate siloxane of low molecular, a plasticizer, an anti-oxidizing agent, an anti-static agent and a UV ray absorbing agent. It should be noted that as shown in FIG. 4, there is another type of shoe 50A, in which a flexible cover 53A without a zip fastener is fixed onto a sole 56A.

In the case where the sole 56 of a clean room shoe is manufactured using the above-described resin base and additives, a predetermined amount of additive is added to a resin material, and kneaded while heating. Then, the resin composition is subjected to injection molding.

In the present invention, it is preferable that the main component of the plasticizer should be one of a calboxylate having a molecular weight of 420 or more, a polyester having a molecular weight of 400 or more, and an epoxy-

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based compound having a molecular weight of 400 or more. It is particularly preferable that the main component of the plasticizer should be at least one of phthalic acid ester-based compounds such as isodecyl phthalate (molecular weight: 447) and lauryl phthalate (molecular weight: 502); aliphatic dibasic acid ester-based compounds such as di-2-ethylhexyl azelate (molecular weight: 413) and di-2-ethylhexyl sebacate (molecular weight: 427); trimellitate ester-based compounds such as tris-2-ethylhexyl trimellitate (molecular weight: 547) and trioctyl trimellitate (molecular weight: 547); polyester-based compounds which are polymers obtained by reactions between dibasic acids such as adipic acid, azelaic acid, sebacic acid and phthalic acid, and glycol or glycerin, especially, propylene glycol adipate-based compounds or butylene glycol adipate-based compounds each having a molecular weight of 2000 to 8000; and epoxy-based compounds such as epoxy fatty ester-based compounds (molecular weight: 400 to 500) and epoxy oil (molecular weight: about 1000).

It should be noted that if the main component of the plasticizer is dibutyl phthalate (molecular weight: 278), dioctyl phthalate (molecular weight: 391) or di-2-ethylhexyl adipate (molecular weight: 371), having a molecular weight of less than 420, it volatilizes from the sole of the shoe at a normal temperature of a clean room (23°C), and is adsorbed on a wafer. Therefore, it is not preferable.

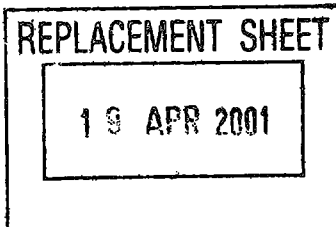
In the present invention, it is preferable that the main component of the anti-oxidizing agent should be at least one of monophenol-based compounds such as stearyl-β-(3, 5-di-t-butyl-4-hydroxyphenyl) propionate (molecular weight: 520.9); bisphenol-based compounds such as 2, 2' -methylene-bis-(4-ethyl-6-t-butylphenol) (molecular weight: 340.5), 2,2'-methylene-bis-(4-ethyl-6-t-

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butylphenol) (molecular weight: 368.5), 4,4'-thiobis-(3-methyl-6-t-butylphenol)
(molecular weight: 358.5), 4,4'-butylidenbis-(3-methyl-6-t-butylphenol)
(molecular weight: 382.6); and high-molecule phenol-based compounds such
as 1,1,3-tris-(2-methyl-4-hydroxy-5-t-butylphenol)butane

5



(Example 4)

To 100 parts by weight of pre-polymer for polyurethane and a hardener (having an average molecular weight of 4000; a product of MITSUI TOATSU KAGAKU), 5 parts by weight of a plasticizer (having a molecular weight of 427; 5 DAIHACHI KAGAKU KOGYO), 0.5 parts by weight of an anti-oxidizing agent (having a molecular weight of 340; YOSHITOMI SEIYAKU KOGYO), 1 part by weight of an anti-static agent (having an average molecular of 450; LION), and 0.5 parts by weight of an ultraviolet ray absorbing agent (having a molecular weight of 334; CHIBA GAIGI CO.) were added, and they were kneaded while 10 heating. Further, to this material, water serving as a sponging agent was added, and dimethylpolysiloxane-polyoxyalkylene co-polymer (having an average molecular weight of 1800; SHINETU KAGAKU KOUGYOU) was further added as a sponging agent. It should be noted that the commercially available sponging controlling agent was not used for the instruments, wearable articles 15 or shoes of the present invention since it releases a great amount of siloxane.

It should be further noted that dimethylpolysiloxane-polyoxyalkylene co-polymer used here was treated at a degree of vacuum of 10 mmHg at 150°C for 3 hours. With use of this material, the injection molding was carried out, and thus a flat plate having dimensions of 100 x 100 mm and a thickness of 10 mm 20 was obtained.

In this case, the main component of the plasticizer was di-2-ethylhexyl sebacate, the main component of the anti-oxidizing agent was 2,2'-methylene-bis-(4-ethyl-6-t-butylphenol), the main component of the antistatic agent was polyethyleneglycol-p-nonylphenyl ether, and the main component of the

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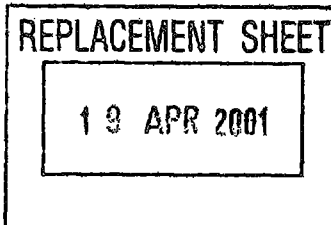
ultraviolet ray adsorbing agent was 2-(2'-hydroxy-3', 5' -di-t-amylphenol) benzotriazol.

A portion (40g) was cut out from the thus obtained wafer carrier. With regard to the sample, organic materials of the additives which were adsorbed on a wafer were examined using Silicon Wafer Analyzer (tradename, to be abbreviated as "SWA" hereinafter, product of GL Science).

The SWA consists of roughly three devices, more specifically, a trap device for heat-desorbing adsorbed components from a wafer to which organic materials were adsorbed, in a helium gas stream, and re-trapping them, a thermal desorption cold trap injector (TCT) device for introducing the re-trapped organic components into a capillary tube which is cooled down with liquid nitrogen, while heat-desorbing the organic components, so as to trap them to be concentrated, and a gas chromatography/mass spectrum (GC/MS) for analyzing the cooled and concentrated components by rapidly heating them in a helium gas stream. By the GC/MS device, a total ion chromatogram (TIC) in which the organic components are separated by the GC device, can be obtained. For each of the peaks, the organic components are subjected to quantitative analysis by the MS device. With the SWA, it is possible to measure

20

25



or more.

(Comparative Example 4)

To 100 parts by weight of polyvinyl chloride resin, 3 parts by weight of dioctyl phthalate as a plasticizer, 2 parts by weight of 2,6-di-t-butyl-p-cresol as
5 an anti-oxidizing agent, and 1.5 parts by weight of N,N'-bis-(2-hydroxyethyl) laurylamide as an antistatic agent were added, and they were kneaded while heating. With use of this material, the injection molding was carried out and thus a flat plate was manufactured. In this case, an ultraviolet absorbing agent, a sponging agent or a sponging controlling agent was not added.

10 The flat plate was examined in terms of the organic material adsorption amount and charge property of a wafer, as in the case of Example 4. As a result, the adsorption amount of wafer was as large as 300 ng. Further, the peaks of the TIC were subjected to the quantitative analysis, and dioctyl phthalate, 2, 6-di-t-butyl-p-cresol, N,N' -bis- (2-hydroxyethyl) laurylamide, and
15 the like were observed.

7. Industrial Applicability

With regard to the wafer carrier, SMIF POD, wafer box, wafer basket, wafer tray, wafer handling jig, which are the instruments of the present invention, the additives added to the resin base are of the types which do not
20 generate a gaseous organic material, and therefore the amount of the organic material components adsorbed to a wafer can be reduced to about 1/5 of the conventional case.

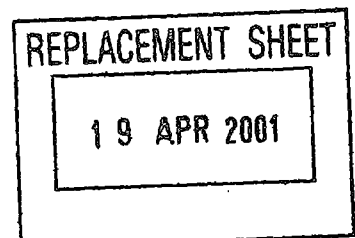
With regard to the wafer carrier, SMIF POD, wafer box, wafer basket, wafer tray, wafer handling jig, which are the instruments of the present
25 invention, the additives added to the resin base are of the types which do not

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easily release a gaseous organic material at room temperature under atmospheric temperature, and therefore the amount of the organic material components adsorbed to a wafer can be reduced to about 1/5 of the conventional case.

5 Further, with regard to the shoe as a wearable article of the present invention, the additives added to the resin base which constitutes a sole are of the types which do not easily generate a gaseous organic material from the resin base at room temperature under atmospheric pressure, and therefore the amount of the organic material components adsorbed to a wafer can be
10 reduced to about 1/5 of the conventional case. Thus, the contamination of wafers with organic materials can be prevented in the manufacture of a semiconductor device, and it becomes possible to improve the yield.



CLAIMS

1. An instrument used for handing a substrate in the manufacture of a semiconductor device in a clean room at room temperature under atmosphere,
5 comprising: a resin base, an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, and an antistatic agent made of a nonion-based compound having a molecular weight of 350 or more, wherein both the anti-oxidizing agent and antistatic agent do not easily generate a gaseous organic material component from the resin base under conditions of
10 room temperature and atmospheric pressure.
2. An instrument according to claim 1, wherein the lubricant contains as a main component at least one selected from the group consisting of aliphatic hydrocarbons having a carbon atom number of 20 or more and higher alcohols having a carbon atom number of 18 or more, and does not contain aliphatic
15 hydorcarbons having a carbon atom number of less than 20 and higher alcohols having a carbon atom number of less than 18.
3. An instrument according to claim 2, wherein the lubricant is made of at least one selected from the group consisting of microcrystalline wax, natural paraffin, synthetic paraffin, polyolefin wax, synthetic branch higher alcohols
20 having a carbon atom number of 18, synthetic branch higher alcohols having a carbon atom number of 20, synthetic branch higher alcohols having a carbon atom number of 24 and oleyl alcohol.
4. An instrument according to claim 1, wherein the resin base contains a plasticizer, and the plasticizer contains as a main component at least one
25 selected from the group consisting of diisodecyl phthalate having a molecular



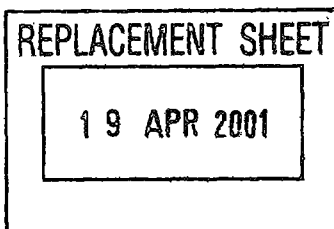
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weight of 447 and dilauryl phthalate having a molecular weight of 502 as carboxylic acid esters having a molecular weight of 420 or more, di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427, tris-2-ethylhexyl trimellate having a molecular weight of 547, trioctyl trimellite having a molecular weight of 547, propyleneglycol adipate having a molecular weight of 2000 to 8000 as polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound having a molecular weight of 400 to 500 as epoxy-based compound having a molecular weight of 400 or more, and epoxydized oil having a molecular weight of 1000 or more, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil having a molecular weight of less than 1000.

5. An instrument according to claim 1, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds, bisphenol-based compounds and high-molecular phenol-based compounds.

6. An instrument according to claim 1, wherein the nonion-based compound serving as the antistatic agent is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N,N' -bis-(diethyleneglycol) stearylamine.



7. An instrument according to claim 1, wherein the instrument is a cassette, a SMIF POD, a wafer tray, a wafer box, a wafer basket or a wafer handling jig, which is used for handing a semiconductor wafer.

8. An instrument according to claim 1, wherein the resin base is made of one selected from the group consisting of a polyolefin, a polycarbonate and a fluorine resin.

9. A wearable article worn by an operator in a clean room at room temperature under atmosphere, comprising: a resin base and an anti-oxidizing agent made of a phenol-based compound having a molecular weight of 300 or more, an antistatic agent made of a nonion-based compound having a molecular weight of 350 or more, and a plasticizer added to the resin base, wherein all of the anti-oxidizing agent, antistatic agent and the plasticizer do not easily generate a gaseous organic material component from the resin base under conditions of room temperature and atmospheric pressure.

10. A wearable article according to claim 9, wherein the plasticizer contains as a main component, at least one selected from the group consisting of diisodecyl phthalate having a molecular weight of 447 and dilauryl phthalate having a molecular weight of 502, di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427 as carboxylic acid esters having a molecular weight of 420 or more, tris-2-ethylhexyl trimellate having a molecular weight of 547, tricoctyl trimellite having a molecular weight of 547, propyleneglycol adipate having a molecular weight of 2000 to 8000 as polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound having a molecular weight of 400 to 500 as epoxy-based compound having a molecular weight of 400 or more, and



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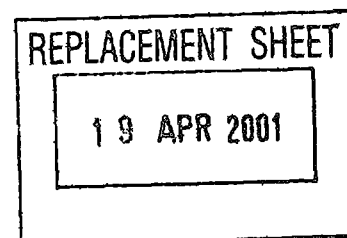
epoxydized oil having a molecular weight of 1000 or more, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-base compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound
5 having a molecular weight of less than 400 or expoxidized oil having a molecular weight of less than 1000.

11. A wearable article according to claim 9, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds, bisphenol-based compounds and high-molecular phenol-
10 based compounds.

12. A wearable article according to claim 9, wherein the nonion-based compound serving as the antistatic agent is made of at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N, N'-bis-
15 (diethyleneglycol) stearylamine.

13. A wearable article according to claim 9, further comprising an ultraviolet absorbing agent, and the ultraviolet absorbing agent is made of a compound having a molecular weight of 300 or more containing at least one selected from the group consisting of salicylic acid-based compounds and benzophenon-
20 based compounds.

14. A wearable article according to claim 9, wherein the resin base is polyvinyl chloride, vinylchloride-based elastomer, chlorine-based polyethylene or urethane resin.



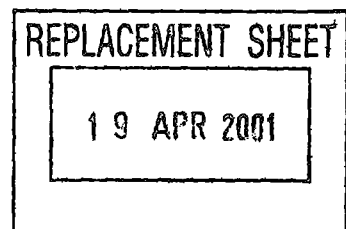
15. A wearable article according to claim 9, wherein the article is a shoe having a sole comprising a prepolymer for urethane resin and a hardener, and a material containing at least one of the additive group consisting of a sponging agent for sponging the urethane resin, silicon-based sponging controlling agent
5 subjected to a vacuum heat process such that the agent does not substantially generate low-molecular siloxane, plasticizer, an anti-oxidizing agent, antistatic agent and an ultraviolet ray absorbing agent.

16. A wearable article according to claim 15, wherein the silicon-based sponging controlling agent is made of at least one selected from the group
10 consisting of dimethylpolysiloxane which does not contain a cyclic siloxane having a silicon atom number of 10 or less, or dimethylpolysiloxane-polyoxyalkylene co-polymer.

17. A wearable article used in a clean room, comprising:
a sole made of a urethane resin and at least one of additives selected
15 from the group consisting of a sponging agent for sponging the urethane resin, a sponging agent for sponging the urethane resin, a silicon-based sponging controlling agent subjected to vacuum heat process such that the agent does not substantially generate cyclic siloxane having a silicon atom number of 10 or less, a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet
20 ray absorbing agent; and

a flexible cover adhered or stitched to the sole.

18. A wearable article according to claim 17, further comprising a fastener member for opening or closing the flexible cover.



19. A shoe worn by an operator in a clean room at room temperature and under atmospheric pressure, comprising: a resin base, and at least one additive selected from the group consisting of a lubricant, a plasticizer, an anti-oxidizing agent, an antistatic agent and an ultraviolet ray absorbing agent, wherein the
5 lubricant contains as a main component a compound made of at least one selected from the group consisting of microcrystalline wax, natural paraffin, synthetic paraffin, polyolefin wax, synthetic branch higher alcohols having a carbon atom number of 18 or more, synthetic branch higher alcohols having a carbon atom number of 20 or more, synthetic branch higher alcohols having a
10 carbon atom number of 24 or more and oleyl alcohol, and not containing aliphatic hydrocarbons having a carbon atom number of less than 20 or higher alcohols having a carbon atom number of less than 18,

the plasticizer is made of a compound which contains as a main component one selected from the group consisting of diisodecyl phthalate
15 having a molecular weight of 447 and dilauryl phthalate having a molecular weight of 502 as carboxylic acid esters having a molecular weight of 420 or more, di-2-ethylhexyl azelate having a molecular weight of 413, di-2-ethylhexyl sebacate having a molecular weight of 427, as carbolic acid diesters having a molecular weight of 420 or more, tris-2-ethylhexyl trimellate having a molecular
20 weight of 547, trioctyl trimellite having a molecular weight of 547, propyleneglycol adipate having a molecular weight of 2000 to 8000 as polyesters having a molecular weight of 400 or more, epoxy fatty acid ester-based compound having a molecular weight of 400 to 500 as epoxy-based compound having a molecular weight of 400 or more, and epoxydized oil having
25 a molecular weight of 1000 or more, and does not contain carboxylic acid esters



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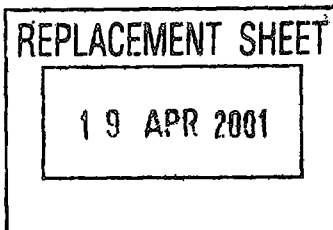
having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil having a molecular weight of less than 1000, and does not contain carboxylic acid esters having a molecular weight of less than 420, polyesters having a molecular weight of less than 400, epoxy-based compounds having a molecular weight of less than 400, epoxy fatty acid ester-based compound having a molecular weight of less than 400 or epoxidized oil having a molecular weight of less than 1000,

the antioxidantizing agent is made of a phenol-based compound having a molecular weight of 300 or more,

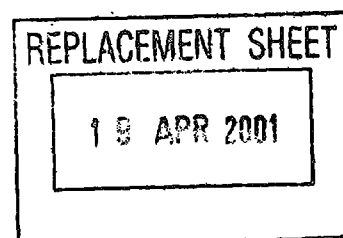
the antistatic agent is made of a nonion-based compound having a molecular weight of 350 or more containing at least one selected from the group consisting of polyoxyethylenealkylamine, polyoxyethylenealkylamide, polyoxyethylenealkylether, polyoxyethylenealkylphenylether and N, N'-bis-(diethyleneglycol) stearylamine, and the ultraviolet ray absorbing agent is made of a compound having a molecular weight of 300 or more, selected from the group consisting of salicylic acid-based compounds and benzophenone-based compounds,

wherein the additives do not easily release a gaseous organic material component from the resin base at room temperature and under atmospheric pressure.

25



20. A shoe according to claim 19, wherein the anti-oxidizing agent is made of at least one selected from the group consisting of monophenol-based compounds, bisphenol-based compounds and high-molecular phenol-based compounds.
- 5 21. A wearable article according to claim 17, further comprising a lubricant, the lubricant containing a main component a compound made of at least one selected from the group consisting of microcrystalline wax, natural paraffin, synthetic paraffin and polyolefin wax, but not containing alcohols.



A B S T R A C T

There are instruments used for handling
a substrate in a clean room at room temperature and
atmospheric pressure, which contain a resin base and at
5 least one additive selected from the group consisting
of a lubricant, a plasticizer, an anti-oxidizing agent
and an antistatic agent, and the additives do not
generate gaseous organic material compound under
conditions of room temperature and atmospheric pressure.

