

ASSEMBLEABLE CHEMICAL FILTER STRUCTURE AND METHOD FOR MANUFACTURING ABSORPTION DEVICE THEREOF

FIELD OF THE INVENTION

[0001] The present invention relates to an assembleable chemical filter structure and a method for manufacturing an absorption device thereof, and in particular to a chemical filter that is comprised of a stack or connection of a plurality of unit cells, wherein each unit cell comprises at least one absorption device containing therein an absorbent, whereby repeated use by replacing the absorbent and releasable stacking in accordance with space requirements can be realized, and wherein the absorption device is manufactured with a process including the steps of applying adhesive, attaching filtering member, heating and bonding, and charging absorbent and features easy manufacturing and repeated use and increase of the amount of absorbent contained therein to thereby enhance filtering performance and achieving the purposes of environmental protection and reduction of costs and is thus applicable to clean rooms in electronic industry, such as integrated circuit (IC), thin film transistor (TFT), and the clean room of semiconductor manufacturing and the likes.

BACKGROUND OF THE INVENTION

[0002] With the development of semiconductor technology, integrated circuits have been manufactured with increasingly reduced line width. The state-of-art technology of the semiconductor industry is now in the level of 45nm manufacturing technology, which will be further reduced to 22nm and 32nm technology in the near future. With the increasing reduction of line width, the airborne molecular contamination (AMC), such as sulfur containing substance, including SO_x, H₂S, DMSO (dimethyl sulfoxide, (CH₃)₂SO), DMS (dimethyl sulfide, (CH₃)₂S), acid substance, including NO_x, base substance, including NH₃, MEA (monoethanol

amine, $\text{NH}_2\text{C}_2\text{H}_4\text{OH}$), volatile organic compounds (VOCs) of low boiling point, including IPA (isopropyl alcohol, $\text{C}_3\text{H}_7\text{OH}$) and acetone, and volatile organic compounds of high boiling point, contained in the external air or present in the clean room may lead to adverse effect to the passing rate of the manufacturing process. To enhance the passing rate, the semiconductor manufacturing facility commonly includes chemical filters in for example an external air conditioning device and an air circulation zone.

[0003] However, the conventional chemical filters are of fixed sizes and thus, the installation site must be modified to suit the chemical filters. Further, the conventional chemical filters occupy a large space and are of high manufacturing costs. In addition, the conventional chemical filters, once saturated, are not easy for replacing the absorbent. The conventional filters contain only a specific absorbent, which is not able to handle and process various chemical contaminants, which may include acid substances, base substances, volatile organic compounds (VOCs), and even mixtures of acid and base substances. Thus, the conventional chemical filters are generally not quite suitable for the designated purposes.

[0004] Figure 12 shows a perspective view of a conventional chemical filter. The conventional chemical filter comprises a frame having air inlet openings and air outlet openings and filtering members fixed between the inlet and the outlet openings. The filtering member is made up of two layers of non-woven fabric **A** interposing therebetween a mixture **B** of hot-melt adhesive powder and absorbent (such as activated charcoal) to form a sandwich structure. Once heated, the hot-melt adhesive powders get molten and have the absorbent attached to and fixed between the two layers of non-woven fabric **A**. The non-woven fabric **A** is further provided with a fine netting screen, such as a steel net, for fixing purposes. Besides the absorbent, the two layers of non-woven fabric **A** also contains therebetween the hot-melt adhesive powders. This makes the amount of absorbent contained between the two layers of the non-woven fabric reduced, leading to reduced overall performance of absorption and filtering. Thus, due to the fact that the conventional chemical filter adopts a fixed manner to fixing the parts, it

is difficult to replace the absorbent once the absorbent gets saturated. This leads to increased costs of the conventional chemical filters.

[0005] Thus, in view of the drawbacks of the conventional structure and the known manufacturing process, the present invention is aimed to provide an assembleable chemical filter structure and a method for manufacturing an absorption device thereof in order to overcome the above discussed drawbacks.

SUMMARY OF THE INVENTION

[0006] An objective of the present invention is to provide an assembleable chemical filter structure that is applicable to filter air with excellent filtering performance, has low manufacturing costs, and can be flexibly stacked and connected in accordance with space requirement, all these being realized by an assembleable chemical filter structure, which is formed by stacking and connecting a plurality of unit cells, each unit cell being comprised of an absorption device having opposite sides to which filtering members are mounted with a support structure arranged between the filtering members for carrying absorbent therein, thereby enhancing the practicability and convenience of the present invention.

[0007] Another objective of the present invention is to provide an assembleable chemical filter structure, comprising an absorption device made up of a support structure and absorbent that are arranged in a replaceable form to make the chemical filter of the present invention suitable for various sites and applications with enhanced filtering performance and reduced pressure loss and further extending the service life of chemical filter, thereby enhancing the practicability and convenience of the present invention.

[0008] A further objective of the present invention is to provide a method for manufacturing an absorption device of a chemical filter, which makes the absorption device through a process comprising the steps of applying adhesive, attaching

filtering member, heating and bonding, and charging absorbent, whereby the manufacturing is made easy and no additional space is occupied by the hot-melt adhesive powders, which leads to an increase of the amount of absorbent contained and enhanced performance of absorption and filtering of airborne molecular contaminants to thereby enhance the overall practicability.

[0009] Yet a further objective of the present invention is to provide a method for manufacturing an absorption of a chemical filter, wherein the absorption device has a support structure to which an opening/closing mechanism is provided to allow replacement of absorbent and repeated use of the absorption device and thus realizing environmental protection and reduction of costs and improving overall practicability, environmental protection, and economic values.

[0010] To realize the above objectives, in accordance with the present invention, an assembleable chemical filter structure includes a plurality of unit cells releasably coupled to each other. Each unit cell includes a unit frame and at least one absorption device. The unit frame forms at least one opening. The absorption device is releasably mounted to the unit frame and includes a support structure, at least two filtering members and an absorbent. The support structure has two opposite outer sides to each which a filtering member is mounted. The absorbent is charged in a receiving space formed between the two filtering members and the support structure. The absorption device is manufactured through a process including steps of applying adhesive, attaching filtering member, heating and bonding, and charging absorbent. As such, when the absorption device gets saturated, the unit cell is releasably removed for replacing the absorption device so as to facilitate replacement and repeated use.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will be apparent to those skilled in the art by reading the following description of preferred embodiments thereof with reference to the drawings, in which:

[0012] Figure 1 is a perspective view of an assembled chemical filter constructed in accordance with the present invention;

[0013] Figure 2 is an exploded view of the chemical filter in accordance with the present invention;

[0014] Figure 3 is a perspective view of a chemical filter in accordance with another assembly of the present invention;

[0015] Figure 4 is a perspective view of a unit cell for constructing the chemical filter of the present invention;

[0016] Figure 5 is an exploded view of the unit cell of the present invention;

[0017] Figure 6 is a cross-sectional view of the unit cell of the present invention;

[0018] Figure 7 is an exploded view of an absorption device that constitutes the unit cell of the present invention;

[0019] Figure 8 is a perspective view illustrating the operation of the chemical filter of the present invention;

[0020] Figure 9 is a cross-sectional view of a unit cell for constructing a chemical filter in accordance with a second embodiment of the present invention;

[0021] Figure 10 is a flow chart showing a method for manufacturing the absorption device in accordance with the present invention;

[0022] Figure 11 is a perspective view of the absorption device constructed in accordance with the method of the present invention; and

[0023] Figure 12 is a perspective view of a conventional chemical filter.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] With reference to the drawings and in particular to Figures 1-8, an assembleable chemical filter structure constructed in accordance with the present invention comprises a plurality of unit cells 1 releasably coupled together. Each unit cell 1 comprises a unit frame 20, which is a hollow body forming at least one opening 21. The opening 21 of the unit frame 20 is formed on a front wall of the unit frame 20. Retention strips 201 are formed in the unit frame 20, inside the opening 21, and are respectively located above and below the opening 21. Opposite left and right side walls and a rear wall of the unit frame 20 are respectively provided, on an inside surface thereof, an inward projecting retention edge 202. The retention edges 202 have heights that are shorter than the heights of the left and right side walls and the rear wall, whereby an accommodation chamber is formed in each of the upper and lower portions of the interior space of the unit frame 20 for effecting an air-tight coupling between the unit frame 20 and absorption devices 30 that eliminates leakage of gas/air. Upper and lower faces of the front wall of the unit frame 20 are each provided with a plurality of spaced ridges 204. A trough 205 is defined between adjacent ridges 204. Further, the ridges 204 formed on the upper face of the front wall of the unit frame 20 are set to correspond in location to the troughs 205 defined in the lower face of the front wall of the unit frame 20, whereby when a plurality of unit cells 1 is stacked in a vertical direction, the troughs 205 defined in the lower face of the front wall of an upper unit cell 1 in the stack are fit over the corresponding ridges 204 formed on the upper face of the front wall of a

lower unit cell 1 of the stack thereby realizing air-tight coupling therebetween. A lateral end of the front wall of the unit frame 20 forms a laterally projecting upper connector 23 on an upper half of the lateral end face of the front wall, while an opposite lateral end of the front wall forms a laterally projecting lower connector 24 on a lower half of the opposite lateral end face of the front wall. The upper connector 23 forms a through hole 231, and the lower connector 24 forms a corresponding through hole 241, whereby when a plurality of unit cells 1 are horizontally (or laterally) stacked or juxtaposed with each other, a threaded bar 60 is inserted through the through hole 231 of the upper connector 23 and the through hole 241 of the lower connector 24 of the unit frames of stacked unit cells 1 for laterally or horizontally connecting the unit cells 1. A lower face of the upper connector 23 and the lower half of the lateral end face of the unit frame 20 below the upper connector 23 are both provided with a plurality of ridges 232 with each two adjacent ridges 232 defining therebetween a trough 233. Also, an upper face of the lower connector 24 and the upper half of the opposite lateral end face of the unit frame 20 above the lower connector 24 are both provided with a plurality of ridges 242 with each two adjacent ridges 242 defining therebetween a trough 243. The ridges 232 on the lower face of the upper connector 23 are arranged to correspond to the troughs 205 defined in the lower face of the front wall, while the ridges 242 on the upper face of the lower connector 24 are arranged to correspond to the troughs 233 defined in the lower face of upper connector 23; the ridges 232 formed on the lateral end face of the unit frame 20 below the upper connector 23 are set to correspond to the troughs 243 defined in the opposite lateral end face of the unit frame 20 above the lower connector 24, whereby when a plurality of unit cells 1 is connected laterally, the ridges 232 of the upper connector 23 of a unit cell 1 on one side of the connection are fit into the troughs 243 of the lower connector 24 of a unit cell 1 on the other side of the connection to realize air-tight coupling between a plurality of laterally connected unit cell 1. Further, the unit frame 20 forms, on the side walls thereof, at least one mounting section 22. The mounting section 22 forms, substantially in a center thereof, a through hole 221. When a plurality of unit cells 1 is temporarily put together, a threaded bar 60 can be inserted through the through holes 221 of the mounting sections 22 to fix the plurality of unit cells 1 that

are stacked in the vertical direction. Further, an upper end of the mounting section 22 forms a cylindrical projection 221a circumferentially surrounding the through hole 221, while a lower end of the mounting section 22 forms a circumferential recess 221b surrounding the through hole 221. The projection 221a corresponds in shape and location to the recess 221b, whereby when unit cells 1 are vertically stacked, the lower end recess 221b of the mounting section of an upper unit cell 1 is fit over the upper end projection 221a of the mounting section 22 of a lower unit cell 1 so that the stacked unit cells 1 can tightly coupled together. The retention strips 201 and the retention edges 202 that are form inside the unit frame 20 respectively delimit an accommodation space in the upper and lower segments of the interior space of the unit frame 20. The left and right side walls of the unit frame 20 are set in a trapezoidal shape to facilitate air flowing through absorbents and reduce loss of pressure of the air flow. The retention strips 201 and the retention edges 202 located inside the unit frame 20 is each provided with an internally threaded hole 203 for mounting the absorption devices 30.

[0025] The chemical filter structure in accordance with the present invention further comprises at least one absorption device 30, which is removably mounted to the unit frame 20. The absorption device 30 is made in the form of a thin flat member and comprises a support structure 40, two filtering members 31, and absorbent 50. Opposite sides of the support structure 40 are respectively coupled to the filtering members 31. The support structure 40 is provided with at least one opening/closing mechanism 41, and the support structure 40 uses the opening/closing mechanism 41 to allow the absorbent 50 to be fit into the interior space defined by the two filtering members 31 covering the support structure 40. The filtering members 31 can be for example non-woven fabric based filtering member, fine netting screens, or other types of filtering members. The support structure 40 is comprised of a frame-like structure made up of a plurality of primary bars 401, a plurality of support bars 402, and four edge walls. The plurality of primary bars 401 is arranged inside the frame-like structure and is connected to two opposite ones of the four edge walls. The plurality of support bars 402 is arranged perpendicular to the primary bars 401 to provide support thereto, and the support

bars 402 have a height (or vertical dimension) smaller than that of the primary bars 401, so that the support structure 40 forms grid-like structure that defines therein a plurality of horizontal extending-through channels. (In an actual application, the support structure 40 can be a frame made up of only a plurality of primary bars 401 and four edge walls (not shown) with the plurality of primary bars 401 arranged inside the frame and connected to two opposite ones of the four edge walls to make the support structure 40 a grid-like structure that defines a plurality of horizontal extending-through channels therein.) The connection between the four edge walls and the primary bars 401 and the connection between the primary bars 401 and the support bars 402 are realized by for example fitting, adhesives, insertion and the likes. The opening/closing mechanism 41 is provided to one edge wall of the support structure 40 that corresponds to the horizontal extending-through channels defined in the support structure 40 for facilitating loading/removal of the absorbent. The opening/closing mechanism 41 comprises a through slot 411 defined in one edge wall of the support structure 40 (namely the one of the edge walls of the support structure 40 that corresponds to the horizontal extending-through channels defined inside the support structure 40) for receiving and releasably engaging a corresponding sealing strip 412 formed on the opening/closing mechanism 41, so as to allow replacement of the absorbent 50 and to prevent leakage of the absorbent 50 that is filled in the absorption device 30. The support structure 40 further comprises at least one fixing section 43 and the fixing section 43 comprises a cylinder that defines a through bore 431 and is formed on an inner surface of the edge walls of the support structure 40. The bore 431 defined through the cylinder can be internally threaded and corresponds in position to the internally-threaded hole 203 of the unit frame 20 when the absorption device 30 is mounted to the unit frame 20. The unit cell 1 further comprises a protective screen 70 on the outer side of the unit frame 20. Further, the upper and lower sides of the unit cell 1 can be simultaneously provided with multiple absorption devices 30, each of which contains therein different absorbents 50.

[0026] To assemble the absorption device 30 (see Figure 7), the two filtering members 31 are first mounted to the opposite sides of the support structure 40, and

the filtering members 31 can be mounted to the opposite sides of the support structure 40 by means of adhesives, bonding and the like to form the plurality of channel-like receiving spaces between the filtering members 31 on the opposite sides of the support structure 40 and the support structure 40 itself. The absorbent 50 is then charged through the slot 411 that is defined in the support structure 40 and constitutes in part the opening/closing mechanism 41 into the receiving spaces formed between the support structure 40 and the two filtering members 31. Thereafter, the sealing strip 412 is tightly fit into the slot 411 of the opening/closing mechanism 41 to completely seal the absorbent 50 against leakage. As such, the assembling of the absorption device 30 is completed.

[0027] To mount the unit frame 20 and the absorption devices 30 of the unit cell 1 (see Figures 5 and 7), firstly, one absorption device 30 is mounted to each of the upper and lower sides of the unit frame 20. In the embodiment illustrated, threading engagement is adopted to mount the unit frame 20 and the absorption device 30 together, wherein the hole 431, which are internally threaded, of the fixing sections 43 of the absorption device 30 are put in alignment with corresponding internally threaded holes 203 of the walls of the unit frame 20 and bolts 432 are inserted through and threadingly engage the holes 431 of the absorption device 30 and the internally-threaded holes 203 of the unit frame 20 to effect fast. Alternatively, the present invention may adopt the threading engagement between bolts and nuts (not shown) to fasten the unit frame 20 and the absorption device 30 together so that when the threads of the hole 431 of the absorption device 30 and the internally-threaded hole 203 of the unit frame 20 fail to properly function after a long term of service, the bolts engaging the nuts can be adopted to ensure further repeated use and extend the service life of the unit cell 1. Further alternatively, the mounting between the unit frame 20 and the absorption device 30 can be realized by means of fitting and snapping on or other types of fastening. When the absorption device 30 is saturated in absorption of foreign objects, the unit cell 1 can be dismounted for replacing the absorbent 50 of the saturated absorption device 30 to realize repeated and further use thereof.

[0028] The releasable connection between multiple unit cells 1 can be realized by vertical stacking of the unit cells 1 (see Figure 3), horizontal or lateral extension or connection of the unit cells 1, or simultaneous vertical stacking and horizontal connection of the unit cells 1 (see Figure 1). Also referring to Figure 2 and 4, to stack the unit cell 1 in the vertical direction, the multiple vertically stacked unit cells 1 are fastened together by having two threaded bars 60 extending through the through holes 221 defined in the mounting sections 22 arranged on the rear ends of the unit frames 20 of the unit cells 1 in the stack so that the stacked unit cells 1 are secured together. To horizontally connect and vertically stack multiple unit cells 1, by means of the upper connectors 23 and the lower connectors 24 formed on the unit frames 20 of the unit cells 1 and further due to the upper connectors 23 and the lower connectors 24 forming corresponding ridges and troughs (the ridges 232 of the upper connector 23 corresponding to the troughs 243 of the lower connector 24; and the troughs 233 of the upper connector 23 corresponding to the ridges 242 of the lower connector 24), the unit cells 1 can joint each other, in a fitting manner, in the horizontal connection. Thereafter, threaded bars 60 are fit through the through holes 231 (which are defined in the upper connectors 23) and the through holes 241 (which are defined in the lower connectors 24) that are provided in the upper connectors 23 and the lower connectors 24 on the opposite lateral ends of the front wall of the unit frames 20 and are aligned with each other to secure the horizontal connection and the vertical stack of the unit cells 1. The present invention further provides a side fastener bar 80, which is configured as a bar having projections to complementarily fit in the void spaces left between the upper connectors 23 and the lower connectors 24 during the stacking of a plurality of unit cells 1.

[0029] Also referring to Figure 10, a flow chart of a method for manufacturing the absorption device of the chemical filter structure in accordance with the present invention. Reference is also made to Figures 11 and 7, the method comprises the following steps:

[0030] STEP ONE: applying adhesive (step 11), wherein a hot-melt adhesive is coated to the surfaces of the support structure 40 of the absorption device 30. The adhesive can be applied manually or by means of an adhesive application device.

[0031] STEP TWO: attaching filtering member (step 12), wherein at least one filtering member 31 is laid on the surface of the support structure 40 of the absorption device 30 to form receiving spaces in the support structure 40. The filtering member 31 can be a non-woven fabric based filtering member or a fine netting screen and a non-woven fabric based filtering member is taken as an example in the present embodiment. The upper and lower sides of the support structure 40 of the absorption device 30, both being coated with the adhesive, each receive at least one non-woven fabric based filtering member 31 attached thereto.

[0032] STEP THREE: heating and bonding (step 13), wherein heating is applied to have the support structure 40 and the filtering members 31 of the absorption device 30 to be bonded together. Heating can be realized by using an oven, an iron, microwave, infrared, and a heater.

[0033] STEP FOUR: charging absorbent (step 14), wherein absorbent 50 is charged into and sealed within the receiving spaces formed between the support structure 40 and the outside filtering members 31 of the absorption device 30.

[0034] The absorption device 30 is made in the form of a thin flat member in order to reduce pressure loss. In accordance with the above described manufacturing method, the absorption device 30 comprises a support structure 40, at least one filtering member 31, and absorbent 50. The support structure 40 comprises a frame-like structure made up of four edge walls connected to each other and arranged inside the frame-like structure are a plurality of primary bars 401 and a plurality of support bars 402, which are connected to each other to form a grid-like structure. Each support bar 402 has a height smaller than that of the primary bars 401, so that the interior of the support structure 40 forms a plurality of extending-through channels for receiving and containing the absorbent 50 therein.

The support structure 40 can be made by plastic injection molding to integrally form the grid-like structure of the connected primary bars 401 and support bars 402.

[0035] Further, after the absorbent 50 is charged, the sealing that retains the absorbent 50 in the receiving spaces formed between the support structure 40 and the outside filtering members 31 of the absorption device 30 can be for example a fixed sealing, which include gluing sealing, hot-melt adhesive sealing, ultrasonic sealing, and the likes, to completely close the opening for charging the absorbent 50 so as to tightly seal the absorbent 50 inside the receiving spaces formed between the support structure 40 and the outside filtering members 31. Alternatively, the sealing that retains the absorbent 50 in the receiving spaces formed between the support structure 40 and the outside filtering members 31 of the absorption device 30 is a releasable sealing, in which the support structure 40 forms, in an edge wall thereof, a through slot 411 through which the absorbent 50 can be charged and removed and a sealing strip 412 is correspondingly and releasably fit into the slot 411 to thereby allow replacement of the absorbent 50 and to prevent leakage of the absorbent 50. The slot 411 and the sealing strip 412 are operated in a corresponding and mating manner to form an opening/closing mechanism 41 to thereby allow replacement of the absorbent 50 and repeated use of the absorption device 30, thus facilitating recycling and reuse of the absorbent 50.

[0036] To manufacture the absorption device 30, in accordance with the manufacturing method of the present invention, the two filtering members 31 are first bonded to the upper and lower sides of the support structure 40 by means of hot-melt adhesives so that a plurality of extending-through channel like receiving spaces is formed between the support structure 40 and the filtering members 31 on the opposite sides of the support structure 40. Thereafter, the absorbent 50 is charged into the receiving spaces formed between the support structure 40 and the two filtering members 31 through the slot 411 of the opening/closing mechanism 41 of the support structure 40, and the sealing strip 412 is employed to seal the slot 411 of the opening/closing mechanism 41 to prevent leakage of the absorbent 50. As such, the manufacturing of the absorption device 30 is completed.

[0037] Referring to Figures 1-11, the features of the present invention reside in that a plurality of unit cells 1 is combined in a releasable manner so that they can be flexibly arranged in accordance with the space requirement. The unit cell 1 is provided therein with one or more absorption devices 30, which is made in the form of a thin and flat member to reduce pressure loss. With the absorption device 30 being formed with a support structure 40 to which two filtering members 31 are attached to form receiving space(s) for absorbent 50, the construction is simplified. With the absorbent 50 contained in the absorption device 30 can be replaced and selected in accordance with requirement and use and further with the unit frame 20 being selectively coupled with multiple absorption devices 30 that contains different absorbent 50, the efficiency for removing airborne molecular contaminant is enhanced and the service life of the chemical filter can also be extended. Due to the structure of the unit cell 1 described above, the costs for mold or die making is reduced. Due to the stackable or connectable arrangement, the space can be used in a more flexible manner. Thus, overall practicability and convenience can be realized. Further, the absorption device 30, which is manufactured with the process including the steps of applying adhesive (step 11), attaching filtering member (step 12), heating and bonding (step 13), and charging absorbent (step 14), is made in the form of a combination of a support structure 40, at least one filtering member 31, and absorbent 50, which can be more easily manufactured and wherein the hot-melt adhesive powders no longer takes the space for receiving and containing the absorbent 50 to thereby increase the effective amount of the absorbent 50 contained in the absorption device 30, leading to improved effectiveness of absorbing and filtering airborne molecular contaminants. Further, the absorption device 30 is formed by attaching at least one filtering member 31 to an outside surface of the support structure 40 (two filtering members 31 being respectively bonded to the upper and lower sides of the support structure 40 in the embodiment illustrated, yet it being noted that a single piece of filtering member 31 can be adopted to wrap around both the upper and lower sides of the support structure 40), and the support structure 40 is further provided with an opening/closing mechanism 41 to form a releasable and openable sealing structure for realizing the replacement of absorbent 50, so that repeated use of the absorption

device 30 can be realized and the removed absorbent 50 that is saturated in absorption of foreign objects can be recycled for environmental protection and cost reduction. To conclude, the present invention is of the advantages of practicability, environmental protection, and having economic values.

[0038] Also referring to Figure 8, to use the present invention, external air enters the unit frame 20 through the opening 21 of the unit frame 20 and flows through the absorption device(s) 30. When the external air is flowing through the absorption device(s) 30, the airborne molecular contaminants are absorbed by the absorbent 50, and thereafter, the air passes through the outside filtering member(s) 31 of the absorption device(s) 30 to complete the filtering operation. Further, the opposite outer sides of the absorption device 30 are selectively provided with protective screens 70 for protecting the absorption device 30 against damage occurring during conveyance and installation thereof.

[0039] Also referring to Figure 9, the unit frame 20 of the unit cell 1 can be selectively coupled with multiple absorption devices 30 for providing various absorbents 50, so as to remove various airborne molecular contaminants when air is flowing through the multiple absorption devices 30. In the embodiment illustrated, two absorption devices 30 are arranged on both the upper and lower sides of the unit frame 20 and the two absorption devices 30 can contain different absorbents 50, with a first absorption device 30a being mounted to one side of the unit frame 20 and a second absorption device 30b being mounted to an outer side of the first absorption device 30a to effect removal of various airborne molecular contaminants. For example, the first absorption device 30a contains an absorbent for absorbing volatile organic compounds of high boiling point, while the second absorption device 30b contains an absorbent for absorbing volatile organic compounds of low boiling point, so that when external air enters the first absorption device 30a, the high boiling point volatile organic compounds are first removed and then when the air enters the second absorption device 30b, the low boiling point volatile organic compounds are removed. In this way, various foreign objects can be removed and

thus the efficiency of removing airborne molecular contaminants can be enhanced, making the present invention more practicable and convenient.

[0040] As shown in Figures 4-7, the assembleable chemical filter structure of the present invention allows stacking of a plurality of unit cell 1 (as shown in Figures 1 and 3), in which each unit cell 1 comprises a unit frame 20 having an opening 21 and the upper and lower sides of the unit frame 20 is each provided, in a releasable manner, with at least one absorption device 30. In the embodiment illustrated, threading engagement is employed to fasten the absorption device(s) 30 to the unit frame 20, in which the absorption device 30 that is manufactured with a method in accordance with the present invention comprises a support structure 40 having four edge walls on which at least one fixing section 43(eight such fixing sections being shown in the embodiment illustrated) is formed. The fixing section 43 comprises a cylinder defining therethrough a bore 431 (internally-threaded hole). The unit frame 20 comprises internally-threaded holes 203 at locations corresponding to the bores 431 of the absorption device 30 so that bolts 432 can be respectively inserted through the bores 431 of the absorption device 30 and the internally-threaded holes 203 of the unit frame 20 to effect fastening therebetween. In use, external air passes through the opening 21 of the unit frame 20 to enter the unit frame 20 and flows through the absorption devices 30 on the upper and lower sides of the unit frame 20 to have the airborne molecular contaminants absorbed and thus removed by the absorbent 50. Thereafter, the air passes through the outside filtering members 31 of the absorption devices 30 to complete the filtering operation. The assembleable chemical filter structure in accordance with the present invention contains the absorption device 30 manufactured in accordance with the present invention to realize replacement of the absorbent 50 and repeated use thereof so that environmental protection is realized and an advantage that there is no need to completely replace the whole construction when the absorbent 50 get saturated is provided to effectively reduce the installation and maintenance costs.

[0041] Although the present invention has been described with reference to the preferred embodiments thereof, it is apparent to those skilled in the art that a variety

of modifications and changes may be made without departing from the scope of the present invention which is intended to be defined by the appended claims.

CLAIMS:

1. An assembleable chemical filter structure, comprising a plurality of unit cells releasably coupled to each other, each unit cell comprising:
a unit frame, the unit frame forming at least one opening; and
at least one absorption device, the absorption device being releasably mounted to the unit frame, the absorption device comprising a support structure, at least two filtering members and an absorbent, the support structure having two opposite outer sides each being coupled to one filtering member, the absorbent being charged in receiving spaces formed between the two filtering members and the support structure;
wherein when the absorption device get saturated, the unit cell is removed for carrying out of replacement of the absorption device whereby repeated use and replacement are realized.
2. The assembleable chemical filter structure as claimed in Claim 1, wherein the support structure of the absorption device is provided with an opening/closing mechanism, whereby when the absorption device get saturated, the opening/closing mechanism is operative to replace the absorbent and thus facilitating repeated use and replacement.
3. The assembleable chemical filter structure as claimed in Claim 1, wherein the unit cells are vertically stacked to be combined together as a unitary arrangement.
4. The assembleable chemical filter structure as claimed in Claim 1, wherein the unit cells are horizontally connected to be combined together as a unitary arrangement
5. The assembleable chemical filter structure as claimed in Claim 1, wherein the unit cells are vertically stacked and horizontally connected to be combined together as a unitary arrangement.

6. The assembleable chemical filter structure as claimed in Claim 1, wherein the unit frame has side wall on which at least one mounting section is formed, the at least one mounting section has a center in which a through hole is formed, wherein when the plurality of unit cells is releasably coupled to each other, a threaded bar extends through the through hole of the mounting section to secure the vertically stacked unit cells.
7. The assembleable chemical filter structure as claimed in Claim 1, wherein the unit frame has a front wall having upper and lower faces each forming a plurality of ridges, two adjacent ones of the ridges forming therebetween a trough, the ridges of the upper face of the front wall of the unit frame corresponding in position to the troughs of the lower face of the front wall of the unit frame, whereby when a plurality of unit cells is vertically stacked, the troughs of the lower face of the front wall of an upper unit cell of the stack are respectively fit to the ridges of the upper face of the front wall of a lower unit cell of the stack so as to form air-tight engagement between stacked unit cells.
8. The assembleable chemical filter structure as claimed in Claim 1, wherein the unit frame has a front wall having a first lateral end having an upper portion forming a laterally projecting upper connector and a second, opposite lateral end face having a lower portion forming a laterally projecting lower connector for effecting horizontal connection of a plurality of unit cells.
9. The assembleable chemical filter structure as claimed in Claim 8, wherein the upper connector forms a first through hole and the lower connector forms a corresponding second through hole and wherein when a plurality of unit cells is releasably coupled to each other, a threaded bar extends through the aligned first and second through holes formed in the stacked upper and lower connectors of the unit frames of the coupled unit cells to effect horizontal connection of the unit cells.
10. The assembleable chemical filter structure as claimed in Claim 8, wherein a

lower face of the upper connector and a lower portion of the first lateral end face of the unit frame below the upper connector are formed with a plurality of ridges, adjacent ones of the ridges forming a trough therebetween, wherein an upper face of the lower connector and an upper portion of the second lateral end face of the unit frame above the lower connector are formed with a plurality of ridges, adjacent ones of the ridges forming a trough therebetween, and wherein the ridges formed on the lower face of the upper connector correspond to the troughs formed in the lower face of the front wall, the ridges formed on the upper face of the lower connector corresponding to the troughs defined in the lower face of the upper connector, the ridges formed on the first lateral end face of the unit frame below the upper connector corresponding to the troughs defined in the second lateral end face of the unit frame above the lower connector, whereby when a plurality of unit cell is horizontally connected to each other, the ridges of the upper connector of a first unit cell are fit to the troughs of the lower connector or a second adjacent unit cell to thereby form air-tight engagement between the horizontally connected unit cells.

11. The assembleable chemical filter structure as claimed in Claim 1, wherein the opening of the unit frame is formed in a front wall of the unit frame, a retention strip being provided both above and below the opening on an inner side of the opening, the unit frame having left and right side walls and rear wall, which are respectively provided, on an inside surface thereof, an inward projecting retention edge, the retention edge having heights that are shorter than heights of the left and right side walls and the rear wall, whereby an accommodation chamber is formed in each of upper and lower portions of the unit frame for effecting air-tight engagement between the unit frame and the absorption device that eliminate leakage of gas.
12. The assembleable chemical filter structure as claimed in Claim 11, wherein the retention strips and the retention edges inside the unit frame 20 is each provided with an internally-threaded hole and wherein the support structure of the absorption device comprises at least one fixing section, the fixing section

comprising a cylinder that defines a through bore and is formed on an inner surface of edge walls of the support structure, the bore defined through the cylinder and internally threaded and corresponding in position to the internally-threaded hole of the unit frame when the absorption device is mounted to the unit frame whereby a bolt is extendible through the bore of the absorption device and further through the internally-threaded hole of the unit frame to secure the unit frame and the absorption device together.

13. The assembleable chemical filter structure as claimed in Claim 1, wherein the left and right side walls of the unit frame are of a trapezoidal shape to facilitate air flowing through the absorbent and reduce pressure loss of the air flow.
14. The assembleable chemical filter structure as claimed in Claim 2, wherein the support structure comprises a frame-like structure made up of a plurality of primary bars and four edge walls, the plurality of primary bars being arranged inside the frame-like structure and connected to two opposite ones of the four edge walls so that the support structure forms a grid-like structure that defines therein a plurality of horizontal extending-through channels, the opening/closing mechanism being provided to one of the edge walls of the support structure that corresponds to the horizontal extending-through channels defined in the support structure for facilitating charging/removal of the absorbent.
15. The assembleable chemical filter structure as claimed in Claim 2, wherein the support structure comprises a frame-like structure made up of a plurality of primary bars, a plurality of support bars, and four edge walls, the plurality of primary bars being arranged inside the frame structure and connected to two opposite ones of the four edge walls, the plurality of support bars being arranged perpendicular to the primary bars to provide support thereto, the support bars having a height smaller than that of the primary bars, so that the support structure forms a grid-like structure that defines therein a plurality of horizontal extending-through channels, the opening/closing mechanism being provided to one of the edge walls of the support structure that corresponds to

the horizontal extending-through channels defined in the support structure for facilitating charging/removal of the absorbent.

- 16.** The assembleable chemical filter structure as claimed in Claim **14** or **15**, wherein the opening/closing mechanism comprises a through slot defined in one of the edge walls of the support structure and a sealing strip receivable in and engageable with the through slot to allow replacement of the absorbent and to prevent leakage of the absorbent.
- 17.** The assembleable chemical filter structure as claimed in Claim **1**, wherein the absorption device is made in the form of a thin and flat member to reduce pressure loss.
- 18.** The assembleable chemical filter structure as claimed in Claim **1**, wherein the filtering member comprises a non-woven fabric based filtering member.
- 19.** The assembleable chemical filter structure as claimed in Claim **1**, wherein the filtering member comprises a fine netting screen.
- 20.** The assembleable chemical filter structure as claimed in Claim **1**, wherein the unit cell comprises a protective screen arranged on one side of the unit frame.
- 21.** The assembleable chemical filter structure as claimed in Claim **1**, wherein the unit cell is provided on a surface thereof through which air flows with a plurality of absorption devices, the plurality of absorption devices respectively receiving and containing therein different absorbents, whereby various airborne molecular contaminants are removed when the air flowing through the plurality of absorption devices.
- 22.** A method for manufacturing an absorption device of a chemical filter, comprising the following steps:
a first step of applying adhesive, wherein a hot-melt adhesive is coated on a

- surface of the support structure of the absorption device;
- a second step of attaching filtering member, wherein at least one filtering member is laid over the surface of the support structure of the absorption device to thereby form a receiving space inside the support structure;
- a third step of heating and bonding, wherein heating is applied to have the filtering member adhesively bonded to the surface of the support structure of the absorption device; and
- a fourth step of charging absorbent, wherein an absorbent is charged into and sealed in the receiving space formed between the support structure of the absorption device and the filtering member.
- 23.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the adhesive is applied to each of upper and lower surfaces of the support structure of the absorption device and wherein a filtering member is positioned on each of the upper and lower surfaces.
- 24.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the adhesive is applied manually or by means of an adhesive application device.
- 25.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the heating and bonding step is carried out by using a heating process of oven heating, ironing, microwave heating, infrared heating, and heating by means of a heater.
- 26.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the support structure comprises a frame-like structure made up of four edge walls connected together, the frame-like structure comprising a plurality of primary bars and a plurality of support bars that are interconnected to form a grid-like structure, the support bars having a height shorter than that of the primary bars so that the support structure forms therein a plurality of through channels for charging absorbent.

- 27.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22** or **26**, wherein the absorbent is charged and sealed in the receiving space formed between the support structure of the absorption device and the filtering member by means of a releasable and openable mechanism and wherein the support structure forms in an edge wall thereof a through slot for charging and removal of absorbent, a sealing strip being tightly fit into and engageable with the slot to thereby form an opening/closing mechanism for allowing replacement of absorbent and repeated user of the absorption device.
- 28.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the absorbent is charged and sealed in the receiving space formed between the support structure of the absorption device and the filtering member by means of fixed sealing, the fixed sealing being selectively realized through gluing, hot-melt adhesive, and ultrasonic bonding to completely close an opening through which the absorbent is charged, so that the absorbent is completely sealed in the receiving space between the support structure and the filtering member.
- 29.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the absorption device is made in the form of a thin and flat member to reduce pressure loss.
- 30.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the filtering member comprises a non-woven fabric based filtering member.
- 31.** The method for manufacturing the absorption device of the chemical filter as claimed in Claim **22**, wherein the filtering member comprises a fine netting screen.