The present application discloses a sample cryogenic storage pipe. The sample cryogenic storage pipe includes a pipe body and a one-piece pipe cap removably configured in the pipe body; there is an opening portion on an upper portion of the pipe body, a sleeve of the pipe body is provided below the opening portion, and a sealed cavity is formed between the sleeve and a pipe wall of the pipe body; the pipe cap includes a pipe cap mating portion and a sample loading rod integrally formed with the pipe cap mating portion, and the sample loading rod, on at least one side thereof, is provided with a storage groove for storing a sample; and the pipe cap mating portion is removably configured on the opening portion of the pipe body, and the sample loading rod is able to be inserted into the sleeve of the pipe body or be removed from the sleeve of the pipe body. The present application also discloses a sample cryogenic storage device. The sample cryogenic storage pipe and device provided by the present application have features of simple structure and easy operation where there is no residual liquid nitrogen when in use.
FIGURE 10

[Diagram with labeled parts: 4, 41, 200, 43, 42, 44, 100]
SAMPLE CRYOGENIC STORAGE PIPE AND DEVICE

RELATED APPLICATION

This application claims priority to Chinese Patent Application No. 201510316797.0, filed on Jun. 10, 2015, and entitled “SAMPLE CRYOGENIC STORAGE PIPE AND DEVICE,” which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present application relates to sample storage technologies, and more particularly, to a sample cryogenic storage pipe and a sample cryogenic storage device for storing all kinds of tissues and cells of a biological, medical laboratory or the like.

BACKGROUND

Currently, a loading tool, used to cryogenically store all kinds of tissues and cells for a biological, medical laboratory or the like, mainly includes three categories: a cryo-loop, a cryostraw and a cryogenic loading rod. There is a higher requirement for a ring mounting technique when the cryo-loop is in use. The respective operation can only be smoothly completed by a strictly-trained and skilled operator. And because the cryo-loop is made of a plastic material and the loading rod is made of a metal material, a certain gap is formed between them, so that liquid nitrogen will reside in the gap. During a melting process, a large amount of bubbles are released or cracks are appeared due to volatilization of the liquid nitrogen, causing loss of one or more samples.

The operation is very complicated when cryostraws and cryogenic loading rods are in use. A longer pipe body occupies lots of storage space and space utilization is low. The pipe body has a smaller diameter and sample information cannot be marked clearly and completely on the pipe body, and thus confusion and/or uncertainty easily occurs in use.

SUMMARY

The present application discloses a sample cryogenic storage pipe and a sample cryogenic storage device with features of simple structure and easy operation where there is no residual liquid nitrogen in use.

In one exemplary embodiment, a sample cryogenic storage pipe includes a pipe body and a one-piece pipe cap removably assembled to the pipe body; there is an opening portion on an upper portion of the pipe body, a sleeve of the pipe body is provided below the opening portion, and a sealed cavity is formed between the sleeve and a pipe wall of the pipe body; the pipe cap comprises a pipe cap mating portion and a sample loading rod integrally formed with the pipe cap mating portion, and the sample loading rod, on at least one side thereof, is provided with a storage groove for storing a sample; the pipe cap mating portion is removably configured on the opening portion of the pipe body, and the sample loading rod is able to be inserted into the sleeve of the pipe body or be removed from the sleeve of the pipe body.

In another exemplary embodiment, a sample cryogenic storage device includes a sample cryogenic storage pipe and an operating lever; the sample cryogenic storage pipe includes a pipe body and a one-piece pipe cap removably configured in the pipe body; there is an opening portion on an upper portion of the pipe body, a sleeve of the pipe body is provided below the opening portion, and a sealed cavity is formed between the pipe body and a pipe wall; the pipe cap includes a pipe cap mating portion and a sample loading rod integrally formed with the pipe cap mating portion, wherein the sample loading rod, on at least one side thereof, is provided with a storage groove for storing a sample; the pipe cap mating portion is removably configured on the opening portion of the pipe body, and the sample loading rod is able to be inserted into the sleeve of the pipe body or be removed from the sleeve of the pipe body; and the operating lever is removably connected with the pipe cap mating portion.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a structure diagram of the sample cryogenic storage pipe provided by the present application;
FIG. 2 is a side view of the pipe body;
FIG. 3 is a schematic diagram of the pipe body provided with a marking region;
FIG. 4 is top view of the pipe body;
FIG. 5 is a side view of the pipe cap;
FIG. 6 is a side view of the pipe cap;
FIG. 7 is top view of the pipe cap;
FIG. 8 is sectional view along A-A of the pipe cap shown in FIG. 7;
FIG. 9 is an enlarged schematic diagram of a top mating portion;
FIG. 10 is a structural diagram of the sample cryogenic storage device provided by the present application;
FIG. 11 is a main view of an operating lever; and
FIG. 12 is a top view of the operating lever.

DETAILED DESCRIPTION

Detailed embodiments of the present application are hereinafter given with reference to the accompanying drawings, wherein identical reference numerals being used to represent identical elements. It should be noted that the words “front”, “back”, “left”, “right”, “up”, “top” and “bottom”, used hereinafter, mean orientations in the drawings, and the words “inside” and “outside” respectively mean the orientations toward and away from geometric center of a certain portion.

The sample cryogenic storage pipe and the sample cryogenic storage device of the present application are mainly used to cryogenically store all kinds of tissues and cells in a biological or medical laboratory. A tissue or cell to be cryogenically stored is called as a sample, and the pipe and device for cryogenically storing the tissue or cell are correspondingly called as the sample cryogenic storage pipe and the sample cryogenic storage device, respectively.

As shown in FIGS. 1-6, a sample cryogenic storage pipe 100 provided by an embodiment of the present application includes a pipe body 1 and a one-piece pipe cap 2 removably provided within the pipe body 1.

The pipe body 1, on the upper portion thereof, is provided with a pipe body opening portion 11, a sleeve 12 of the pipe body is provided below the opening portion 11, and a sealed cavity 14 is formed between the sleeve 12 and a pipe wall 10 of the pipe body 1.
The pipe cap 2 includes a pipe cap mating portion 21 and a sample loading rod 22 integrally formed with the pipe cap mating portion 21, and the sample loading rod 22, on at least one side thereof, is provided with a storage groove 221 for storing samples.

The pipe cap mating portion 21 is removably configured on the opening portion 11 of the pipe body, and the sample loading rod 22 may be inserted into the sleeve 12 or removed from the sleeve 12.

That is, the sample cryogenic storage pipe 100 mainly consists of the pipe body 1 and the pipe cap 2. The pipe cap 2 is a one-piece pipe cap, which is integrally formed as a whole, so that there is no gap between all of connections of the pipe cap 2, preventing residual liquid nitrogen from being trapped in the pipe cap 2.

The pipe body 1, on the upper end thereof, is provided with a pipe body opening 11, and is sealed on the bottom end thereof. The pipe body 1 is provided with a pipe body sleeve 12 therein, which is located below the opening portion 11. The sealed cavity 14, used for storing a refrigerant 3, is formed between the sleeve 12 and the pipe wall 10 of the pipe body 1. In an exemplary embodiment, the sleeve 12 is located in the center of the pipe body 1 so that the sealed cavity 14 evenly surrounds the sleeve 12, and thus the refrigerant 3 is evenly arranged around the sleeve 12, to make the ambient temperature around the sleeve 12 consistent.

The pipe cap 2 includes the pipe cap mating portion 21 and the sample loading rod 22. The sample loading rod 22 is integrated with the pipe cap mating portion 21, so as to form the one-piece pip cap 2 mentioned above. There is no gap between the sample loading rod 22 and the pipe cap mating portion 21. Therefore, there is no residual liquid nitrogen when the pipe cap is removed from the liquid nitrogen. Without residual liquid nitrogen in use, the respective defect is avoided, that is, the samples will not be lost or cracked due to a large amount of bubbles released by the volatilization of the liquid nitrogen during cryogenic storage.

The sample loading rod 22 is provided with a storage groove 221 thereon for storing samples. Certainly, two or more storage grooves 221 can be symmetrically provided as required. The one or more samples are placed in the storage groove 221 in use. The one or more samples are not lost from the storage groove 221 during the movement of the device.

During the connecting operation, the pipe cap mating portion 21 is configured on the opening portion 11 and removably connected with the opening portion 11. That is, the pipe cap mating portion 21 can be mounted on the opening portion 11 or removed from the opening portion 11. A connection way, such as a thread connection, a key connection, a pin connection or the like, may be adopted.

After the connecting operation, the sample loading rod 22 is inserted into the sleeve 12, wherein the bottom end of the sleeve 12 is sealed and the storage groove 221 is also located in the sleeve 12, so as to prevent the sample from being polluted by contacting with the environment. When the pipe cap mating portion 21 is removed, the movement of the sample loading rod 22 with the pipe cap mating portion 21 enables the sample loading rod 22 to be pulled out of the sleeve 12.

In an exemplary embodiment, the pipe body 1, which is of a cylindrical shape or a cuboid shape, is made of a plastic material. The pipe cap 2 is made of a metal material or plastic material, all parts (such as the pipe cap mating portion 21 and the sample loading rod 22) of which are made of the same material, to ensure that all parts can be integrally formed.

One of various metals (such as copper, iron, stainless steel, aluminum magnesium alloy, aluminum, tin, etc.) can be used as the metal material; and one of various plastics (such as polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), ABS, polymethyl methacrylate (PMMA), and polyamide (PA), etc.) can be used as the plastic material.

In conclusion, by providing the pipe cap in a one-piece manner, the pipe cap mating portion thereof is integrally formed with the sample loading rod, and there is no gap there between, so that there is no residual liquid nitrogen in the gap when the pip cap is removed from the liquid nitrogen. The sample cryogenic storage pipe provided by the present application avoids the respective defect, that is, the samples will not be lost or cracked due to a large amount of bubbles released by the volatilization of the liquid nitrogen during cryogenic storage during storage. Therefore, the loss of sample is avoided during the movement of the device.

Referring now to FIGS. 8-10, the pipe cap mating portion 21 includes a top mating portion 23 for matching and connecting an external operating lever 4 and a bottom mating portion 24 for matching and connecting the pipe body 1.

The top mating portion 23 includes a side wall 231 provided around the perimeter of the bottom mating portion 24 and at least one bayonet portion 25 provided on the side wall 231. A mounting cavity 26, used for inserting one end of the operating lever 4 into therein, is formed between the side wall 231 and the bottom mating portion 24.

The top mating portion 23 and the bottom mating portion 24 are integrally formed to form the pipe cap mating portion 21. The side wall 231 of the top mating portion 23 is provided around the perimeter of the bottom mating portion 24. Thus, the mounting cavity 26 is formed between the side wall 231 arranged in the surrounding manner and the bottom mating portion 24. In order to match the external operating lever 4 easily, the side wall 231 is provided with at least one bayonet portion 25. In an exemplary embodiment, two bayonet portions 25 are symmetrically provided.

In use, one end of the operating lever 4 is inserted into the mounting cavity 26 and is tightly locked in the mounting cavity 26 by the bayonet portion 25, so that it is convenient for the operating lever 4 to move the pipe cap 2, so as to insert the pipe cap 2 into the liquid nitrogen or to remove the pipe cap 2 from the liquid nitrogen.

Referring now to FIG. 9, the bayonet portion 25 is an L-shaped bayonet 251, wherein an opening 252 of the L-shaped bayonet 251 is formed on a top face 232 of the side wall 231. Two portions are integrally formed into the bayonet 251 that is in a shape of L. These two portions are a first portion 254 vertically provided on the side wall 231 and a second portion 255 horizontally provided on the side wall 231. The first portion 254 is communicated to the top face 232 of the side wall 231, so that the opening 252 of the L-shaped bayonet 251 is formed on the top face 232 of the side wall 231. The second portion 255, that is transversally arranged, is located on the side wall 231.
As shown in FIG. 10, when one end of the operating lever 4 is inserted into the mounting cavity 26, a protrusion 43 of the end of the operating lever 4 enters into the bayonet portion 25 from the opening 252. The protrusion 43 first enters into the first portion 254 and then enters into the second portion 255 by rotating the operating lever 4, so as to connect the operating lever 4 with the pipe cap 2 together. The operating lever 4 can be removed by being rotated reversely.

Referring now to FIG. 9, a tail end of the L-shaped bayonet 251, which is a tail end of the second portion 255, also forms an additional bayonet 253 extending towards the top face 232 of the side wall 231. The additional bayonet 253 is integrally formed on the tail end of the second portion 255 and extends toward the top face 232, and the extending orientation is the same as that in the first portion 254. After the protrusion 43 enters into the second portion 255, the operating lever 4 can continue to be rotated, so that the protrusion 43 is located in the tail end of the second portion 255. At this time, the protrusion 43 is tightened in the additional bayonet 253 by pulling up the operating lever 4 and/or by an elastic component provided on the end of the operating lever 4, so as to tightly connect the operating lever 4 with the pipe cap 2 together.

Referring now to FIGS. 1-3, a connection portion 13 of the pipe body is provided between the opening portion 11 and the sleeve 12, and the bottom mating portion 24 is removable connected within the connection portion 13 of the pipe body, and the top mating portion 23 covers the opening portion 11 of the pipe body. The bottom mating portion 24 can be connected with the connection portion 13 of the pipe body by a connection way such as a thread connection, a key connection or a pin connection, so that the bottom mating portion 24 can be mounted in the connection portion 13 of the pipe body, and also can be removed from the connection portion 13 of the pipe body.

In an exemplary embodiment, both the pipe body 1 and the pipe cap 2 have circular cross sections. The pipe body 1 has a diameter of 5-20 mm and a height of 10-110 mm. The top mating portion 23 of the pipe cap 2 has a diameter of 5-20 mm and a height of 2-10 mm; the bottom mating portion 24 has a diameter of 3-18 mm and a height of 2-10 mm; and the sample loading rod 22 has a diameter of 0.5-16 mm and a height of 5-90 mm. With reasonable height and width of pipe body 1 and the pipe cap 2, the utilization of the cryogenic storage space can be maximized.

Referring now to FIG. 13, the sealed cavity 14 is filled with the refrigerant 3. By placing the refrigerant 3 in the sealed cavity 14, the sample cryogenic storage pipe 100 outside the liquid nitrogen can be kept at a low temperature for a period of time. The refrigerant 3 in the present application is an ultralow temperature coolant. The ultralow temperature coolant, being a high molecular polymer which has a plurality of different traits: liquid state, semi liquid state, all solid state, soft gel state and hard gel state, can maintain an ultralow temperature from −30°C to −80°C for a certain time period. LD10-B1 granular type, LD10-B2 gel type, LD10-B3 liquid type, LD10-B4 jelly type, LD10-B5 colloid type or LD10-B6 gel type can be the choice for the refrigerant 3.

Referring now to FIG. 7, the pipe cap mating portion 21 is provided with a vent 27 spaced apart from the sample loading rod 22, wherein the vent 27 runs through upper and lower surfaces of the pipe cap mating portion 21. The vent 27 is specifically provided at the bottom mating portion 24, and runs through upper and lower surfaces of the bottom mating portion 24. The vent 27, spaced apart from the sample loading rod 22, is not in line with the sample loading rod 22. The vent 27 can be provided on a main body of the bottom mating portion 24, or also can be provided at an edge of the bottom mating portion 24. The vent 27 maintains a balance between a gas-pressure in the sleeve of the pipe body and the pressure outside, which avoids the situation that the pipe cap 2 is pushed out or the pipe body bursts due to high pressure in the sleeve 12 of the pipe body when the liquid nitrogen is volatilized, and avoids the loss of the samples.

In an exemplary embodiment, the cross-sectional of the storage groove 221 is in a shape of U or in a shape of V. The storage groove 221 has a length of 0.5-82 mm and a depth of 0.2-8 mm, and also can be arranged in other form. In use, the one or more samples are maintained to be placed within the V-shaped or U-shaped storage groove 221. When the sample loading rod is moved, the one or more samples remain within the V-shaped or U-shaped storage groove 221 so as to be avoided to be lost.

Referring now to FIG. 3, the pipe body 1 is provided with a marking region 15 where information of the sample to be processed can be recorded first so that confusion is avoided. The marking region 15 may be rectangular or square; and the marking region 15 may be a transparent coating or a coating with respective color. In an exemplary embodiment, the coating with white color has an area of 20 mm2-6000 mm2.

In conclusion, the sample cryogenic storage pipe provided by the present application, where there is no residual liquid nitrogen, has features of simple structure and easy operation; and the height and width of the pipe body and the pipe cap thereof are reasonable, so that utilization of the cryogenic storage space can be maximized, and sample information can be marked in detail in the marking region, so as to avoid confusion and uncertainty.

As shown in FIG. 10, a sample cryogenic storage device 200 provided by an embodiment of the present application includes a sample cryogenic storage pipe 100 and an operating lever 4.

As shown in FIGS. 1-6, the sample cryogenic storage pipe 100 includes the pipe body 1 and the one-piece pipe cap 2 removably configured in the pipe body 1.

The pipe body 1, on the upper portion thereof, is provided with the opening portion 11, the sleeve 12 of the pipe body is provided below the opening portion 11, and the sealed cavity 14 is formed between the sleeve 12 and the pipe wall 10 of the pipe body 1.

The pipe cap 2 includes the pipe cap mating portion 21 and the sample loading rod 22 integrally connected with the pipe cap mating portion 21, and the sample loading rod 22, on at least one side thereof, is provided with the storage groove 221 for storing the samples.

The pipe cap mating portion 21 is removably configured on the opening portion 11 of the pipe body, and the sample loading rod 22 can be inserted into the sleeve 12 or removed from the sleeve 12. The operating lever 4 is removably connected with the pipe cap mating portion 21.

That is, the sample cryogenic storage device 200 mainly consists of the sample cryogenic storage pipe 100 and the operating lever 4.
The structure, construction and working principle of the sample cryogenic storage pipe 100 have been introduced in detail hereinbefore, which will not be described redundantly herein.

The operating lever 4 is removably connected to the pipe cap mating portion 21, so that the operating lever 4 can match the pipe cap mating portion 21 in use, and thus moving the pipe cap 2. The pipe cap 2 is placed in the pipe body 1. After the operation is completed, the operating lever 4 is removed from the pipe cap 2 and the cryogenic storage pipe is put into a corresponding storage position, so as to cryogenically store the samples.

In order to meet requirements of low temperature and refrigeration, the sealed cavity 14 is filled with the refrigerant 3, so that the sample cryogenic storage pipe 100 outside the liquid nitrogen can be kept at a low temperature for a period of time, which benefits the cryogenic storage.

The operating lever 4 may be made of metal material or plastic material. One of various metals (such as copper, iron, stainless steel, aluminum magnesium alloy, aluminum, tin, etc.) can be used as the metal material; one of various plastics (such as polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polyethylene (PS), ABS, polymethyl methacrylate (PMMA), polyamide (PA), etc.) can be used as the plastic material.

In conclusion, in the sample cryogenic storage device provided by the present application, by making the pipe cap in a one-piece form, the pipe cap mating portion thereof integrally formed with the sample loading rod, and there is no gap there between, and there is no residual liquid nitrogen in the gap when the pipe cap is removed from the liquid nitrogen, so as to avoid the respective defect that samples are lost due to a large amount of bubbles released by the volatilization of the liquid nitrogen or cracks occurred in the volatilization of the liquid nitrogen during storage. By providing the storage groove on the sample loading rod, it is avoided that samples are lost during the movement. The pipe cap is moved by the operating lever so that the respective operation is convenient to cryogenically store the samples.

Referring now to FIGS. 10-12, the operating lever 4 includes a main body 41 and a connection portion 42 provided on one end of the main body 41, and at least one outwardly extended protrusion 43 is arranged on a lateral side 421 of the connection portion 42.

As shown in FIGS. 5-8, the pipe cap mating portion 21 includes a top mating portion 23 for matching and connecting the operating lever 4 and a bottom mating portion 24 for matching and connecting the pipe body 1.

The top mating portion 23 includes a side wall 231 provided around the perimeter of the bottom mating portion 24 and at least one bayonet portion 25 provided on the side wall 231, wherein the mounting cavity 26 is formed between the side wall 231 and the bottom mating portion 24.

The connection portion 42 of the operating lever is removably matched within the mounting cavity 26, and the protrusion 43 is removably engaged within the bayonet portion 25.

The main body 41 of the operating lever and the connection portion 42 of the operating lever may be integrally formed with each other, the lateral side 421 of the connection portion 42 of the operating lever is provided with at least one protrusion 43. The protrusion 43 extends outwardly, wherein “extend outwardly” means that the protrusion 43 protrudes by extending toward the direction away from the connection portion 42 of the operating lever, in the orientation that the protrusion 43 is perpendicular to the main body 41 of the operating lever. Two or more protrusions 43 can be symmetrically provided as required, the number of which corresponds to the number of the bayonet portions 25.

The connection portion 42 of the operating lever can be circular or square that matches the shape of the mounting cavity 26. A circular connection portion may have a diameter of 2-18 mm and a height of 2-10 mm. The main body 41 of the operating lever is a cylindrical or cuboid rod body. A cylindrical main body may have a diameter of 1-18 mm and a height of 10-400 mm.

The structure and construction of the top mating portion 23 have been introduced in detail hereinbefore, which will not be described redundantly herein.

The connection portion 42 of the operating lever is removably matched within the mounting cavity 26, which means that the connection portion 42 of the operating lever can be mounted and matched within the mounting cavity 26 and also can be removed from the mounting cavity 26. The protrusion 43 is removably engaged within the bayonet portion 25, which means that the protrusion 43 can be engaged within the bayonet portion 25 and also can be removed from the bayonet portion 25.

When the operating lever 4 is connected with the top mating portion 23, the connection portion 42 of the operating lever is matched within the mounting cavity 26, and the protrusion 43 is engaged with the bayonet portion 25, so that a tight connection there between is achieved, in order to conveniently move the pipe cap 2 into the liquid nitrogen or remove the pipe cap 2 from the liquid nitrogen. When the operating lever 4 is removed from the top mating portion 23, the protrusion 43 is disengaged from the bayonet portion 25, and the connection portion 42 of the operating lever is pulled out from the mounting cavity 26, to separate the operating lever from the top mating portion, in order to conveniently place the pipe cap 2 in the pipe body 1 and cryogenically store the samples.

Referring now to FIGS. 8-12, the bayonet portion 25 is the L-shaped bayonet 251, the opening 252 of the L-shaped bayonet 251 is formed on the top face 232 of the side wall 231. The protrusion 43 is engaged within the L-shaped bayonet 25.

As mentioned previously, for the L-shaped bayonet 251, two portions are integrally formed into the L-shape. These two portions are the first portion 254 vertically provided on the side wall 231 and the second portion 255 horizontally provided on the side wall 231. The first portion 254 is communicated to the top face 232 of the side wall 231, so that the opening 252 of the L-shaped bayonet 251 is formed on the top face 232 of the side wall 231. The second portion 255, that is transversally arranged, is located on the side wall 231.

As shown in FIG. 10, when the connection portion 42 of the operating lever is inserted into the mounting cavity 26, the protrusion 43 enters into the bayonet portion 25 from the opening 252. The protrusion 43 first enters into the first portion 254 and then enters into the second portion 255 by rotating the operating lever 4, so as to connect the operating lever 4 with the pipe cap 2 together. The protrusion 43 can be removed from the L-shaped bayonet 251 by rotating the operating lever 4 reversely.
Referring now to FIGS. 8-12, the tail end of the L-shaped bayonet 251 also forms the additional bayonet 253 extending towards the top face 232 of the side wall 231, and the protrusion 43 is engaged within the additional bayonet 253.

The tail end of the L-shaped bayonet 251 is a tail end of the second portion 255. The additional bayonet 253 is integrally formed on the tail end of the second portion 255, and extends toward the top face 232. The extending direction is the same as that in the first portion 254. After the protrusion 43 enters into the second portion 255, the operating lever 4 can continue to be rotated, so that the protrusion 43 is on the tail end of the second portion 255. At this time, the protrusion 43 is tightened in the additional bayonet 253 by pulling up the operating lever 4 or by an elastic component provided on the end of the operating lever 4, so as to tightly connect the operating lever 4 with the pipe cap 2 together.

Referring now to FIGS. 10-12, the connection portion 42 of the operating lever is also provided with an elastic component 44 which is in a compression state when the connection portion 42 of the operating lever is matched within the mounting cavity 26, in order to push the protrusion 43 into the additional bayonet 253, so that the protrusion 43 is tightened in the bayonet portion 25, so as to tightly connect the operating lever 4 with the pipe cap 2 together. In an exemplary embodiment, the elastic component 44 is a spring.

Referring now to FIGS. 1-3, the connection portion 13 of the pipe body is provided between the opening portion 11 and the sleeve 12, and the bottom mating portion 24 is removably connected within the connection portion 13 of the pipe body, and the top mating portion 23 covers the opening portion 11 of the pipe body. The bottom mating portion 24 can be connected with the connection portion 13 of the pipe body by a connection way such as the thread connection, the key connection or the pin connection, so that the bottom mating portion 24 can be mounted in the connection portion 13 of the pipe body, and also can be removed from the connection portion 13 of the pipe body.

Referring now to FIGS. 1-3, the sealed cavity 14 is filled with the refrigerant 3. By placing the refrigerant 3 in the sealed cavity 14, the sample cryogenic storage pipe 100 outside the liquid nitrogen can be kept at a low temperature for a period of time. The refrigerant 3 in the present application is an ultra-low temperature coolant. The ultralow temperature coolant, being a high molecular polymer which has a plurality of different traits: liquid state, semi liquid state, all solid state, soft gel state and hard gel state, can maintain an ultralow temperature from −30° to −80° for a certain time period. LD10-B1 granular type, LD10-B2 gel type, LD10-B3 liquid type, LD10-B4 jelly type, LD10-B5 colloidal type or LD10-B6 gel type can be the choice for the refrigerant 3.

Referring now to FIG. 7, the pipe cap mating portion 21 is provided with a vent 27 spaced apart from the sample loading rod 22, which runs through upper and lower surfaces of the pipe cap mating portion 21. The vent 27 is specifically provided on the bottom mating portion 24, and runs through upper and lower surfaces of the bottom mating portion 24. The vent 27, spaced apart from the sample loading rod 22, is not in line with the sample loading rod 22. The vent 27 can be provided on the main body of the bottom mating portion 24, or also can be provided at the edge of the bottom mating portion 24. The vent 27 maintains a balance between the gas-pressure in the sleeve 12 of the pipe body and the pressure outside, so as to avoid the situation that the pipe cap 2 is pushed out or the pipe body bursts due to the high pressure in the sleeve 12 of the pipe body when the liquid nitrogen volatilizes, and avoid the loss of the one or more samples.

In an exemplary embodiment, the cross-section of the storage groove 221 is in a shape of U or in a shape of V. In use, the sample is placed within the V-shaped or U-shaped storage groove 221. When the sample loading rod is moved, the one or more samples are kept within the V-shaped or U-shaped storage groove 221, to avoid the loss of the one or more samples.

Referring now to FIG. 3, the pipe body 1 is provided with a marking region 15 where information of the sample to be processed can be recoded firstly so as to avoid confusion. The marking region 15 may be rectangular or square, and the marking region 15 may be a transparent coating or a coating with respective color. In an exemplary embodiment, the coating with white color has an area of 20 mm2-6000 mm2.

A usage of the sample cryogenic storage device 200 provided by the present application is as follows:

1. filling or pasting the sample information on the marking region 15 of the pipe body 1;
2. tightly connecting the operating lever 4 with the pipe cap 2 by means of the bayonet portion 25, and removing the pipe cap 2 from the pipe body 1 by the operating lever 4, then the pipe cap 2 being set aside along with the pipe body 1, for waiting to be used;
3. after the sample is processed by a cryoprotective agent, holding a transferring tool by one hand and holding the operating lever 4 by the other hand, orienting the storage groove 221 on the sample loading rod 22 to face towards the operator himself/herself, and placing the sample and a little amount of the cryoprotective agent within the storage groove 221 by using the transferring tool;
4. then, holding the operating lever 4 by one hand to immediately place the whole pipe cap 2 within clean liquid nitrogen and making sure it remains below the liquid level of the liquid nitrogen, and then picking up the pipe body 1 with a pair of tweezers or forceps and placing it below the liquid level of the liquid nitrogen, standing for some time;
5. then, tightly connecting the pipe cap 2 with the pipe body 1 below the liquid level of the liquid nitrogen;
6. and then, taking off the operating lever 4 from the pipe cap 2, and placing the sample cryogenic storage pipe 100 in a corresponding storage position with the pair of tweezers or forceps, and making the respective record.

By adopting the technical solution mentioned above, the beneficial effects are as follows:

1. In the sample cryogenic storage pipe and sample cryogenic storage device disclosed above, by arranging the pipe cap in a one-piece manner, the pipe cap mating portion thereof is integrally formed with the sample loading rod and there is no gap there between, and when the pipe cap is taken out of the liquid nitrogen, residual liquid nitrogen is not trapped in the pipe cap. The sample cryogenic storage pipe and the sample cryogenic storage device provided by the present application avoids the defect of the loss of samples caused by a large amount of bubbles released by the vola-
utilization of the liquid nitrogen or cracks occurred in the volatilization of the liquid nitrogen during storage.

[0090] In the sample cryogenic storage pipe and sample cryogenic storage device disclosed above, by providing a top mating portion of the pipe cap mating portion with a bayonet portion, the sample cryogenic storage pipe and the sample cryogenic storage device are easy to connect with the operating lever. In use, one end of the operating lever is connected with the bayonet portion, so that it is convenient for a user to move and operate it.

[0091] By providing a vent, the sample cryogenic storage pipe and the sample cryogenic storage device maintains a balance between the gas-pressure in the sleeve of the pipe body and the pressure outside, so as to avoid the situation that the pipe cap is pushed out or the pipe body bursts due to high pressure in the sleeve of the pipe body when the liquid nitrogen volatilizes, and avoids the loss of the samples.

[0092] By providing the pipe body with a marking region, the sample cryogenic storage pipe and the sample cryogenic storage device can avoid the confusion in use.

[0093] To sum up, the sample cryogenic storage pipe and the sample cryogenic storage device disclosed above where there is no residual liquid nitrogen have features of simple structure and easy operation; and height and width of the pipe body and the pipe cap thereof are reasonable, so that utilization of the cryogenic storage space can be maximized, and detailed sample information can be marked in the marking region, which does not cause confusion and uncertainty.

[0094] The technical solutions mentioned above can be combined as required to reach best technical effect.

[0095] The foregoing is merely embodiments of the present application. It should be pointed out that sever other variants also can be made on the basis of the principle of the present application, which shall be included in the protection scope of the present application.

What is claimed is:

1. A sample cryogenic storage pipe, comprising:
a pipe body, comprising:
an upper portion having an opening portion,
a sleeve deposited below the opening portion,
a pipe wall, and
a sealed cavity formed between the sleeve and the pipe wall; and
a pipe cap removably coupled to the pipe body, comprising:
a mating portion removably coupled to the opening portion of the pipe body, and
a sample loading rod integrally formed with the mating portion, configured to be moved into and out of the sleeve of the pipe body, and
a storage groove for storing a sample, disposed on at least one side of the sample loading rod.

2. The sample cryogenic storage pipe according to claim 1 wherein the mating portion comprises:
a top mating portion configured to removably couple with an operating lever, and
a bottom mating portion removably coupled to the opening portion of the pipe body,
wherein the top mating portion comprises:
a side wall disposed around the perimeter of the bottom mating portion, wherein the side wall has at least one bayonet mount opening, and
a mounting cavity configured to receive the operating lever, wherein the mounting cavity is formed by the side wall and the bottom mating portion.

3. The sample cryogenic storage pipe according to claim 2 wherein the at least one bayonet mount opening is an L-shaped opening having an open end at a top surface of the side wall and a closed end disposed within the side wall.

4. The sample cryogenic storage pipe according to claim 2 wherein the closed end of the L-shaped opening comprises a recess extending toward the top surface of the side wall.

5. The sample cryogenic storage pipe according to claim 2 wherein the pipe body further comprises a connection portion disposed between the opening portion and the sleeve, wherein when the pipe cap is coupled to the pipe body, the bottom mating portion of the pipe cap removably couples to the connection portion of the pipe body and the top mating portion of the pipe cap covers the opening portion of the pipe body.

6. The sample cryogenic storage pipe according to claim 1 wherein the sealed cavity is filled with a refrigerant.

7. The sample cryogenic storage pipe according to claim 2 wherein the mating portion of the pipe cap further comprises a vent connecting an upper surface and a lower surface of the mating portion, wherein the vent is spaced apart from the sample loading rod.

8. The sample cryogenic storage pipe according to claim 1 wherein the storage groove has a cross-section of a U-shape or a V-shape.

9. The sample cryogenic storage pipe according to claim 1 wherein the pipe body comprises a marking region.

10. A cryogenic storage device, comprising:
a storage pipe, comprising:
a pipe body, comprising:
an upper portion having an opening portion,
a sleeve deposited below the opening portion,
a pipe wall, and
a sealed cavity formed between the sleeve and the pipe wall, and
a pipe cap removably coupled to the pipe body, comprising:
a mating portion removably coupled to the opening portion of the pipe body, and
a sample loading rod integrally formed with the mating portion, configured to be moved into and out of the sleeve of the pipe body, and
a storage groove for storing a sample, disposed on at least one side of the sample loading rod, and
an operating lever configured to removably couple to the mating portion of the pipe cap.

11. The sample cryogenic storage device according to claim 10 wherein the operating lever comprises:
a main body,
a connection portion disposed at an end of the main body, and
at least one protrusion extending outward from the main body on a lateral side of the connection portion, wherein the mating portion comprises:
a top mating portion configured to removably couple with the operating lever, and
a bottom mating portion removably coupled to the opening portion of the pipe body,
wherein the top mating portion comprises:
a side wall disposed around the perimeter of the bottom mating portion, wherein the side wall has at least one bayonet mount opening, and
15. The sample cryogenic storage device according to claim 11, wherein the pipe body further comprises a connection portion disposed between the opening portion and the sleeve, wherein when the pipe cap is coupled to the pipe body, the bottom mating portion of the pipe cap removably couples to the connection portion of the pipe body and the top mating portion of the pipe cap covers the opening portion of the pipe body.

16. The sample cryogenic storage device according to claim 10 wherein the sealed cavity is filled with a refrigerant.

17. The sample cryogenic storage device according to claim 10 wherein the mating portion of the pipe cap further comprises a vent connecting an upper surface and a lower surface of the mating portion, wherein the vent being spaced apart from the sample loading rod.

18. The sample cryogenic storage device according to claim 10 wherein the storage groove has a cross-section of a U-shape or a V-shape.

19. The sample cryogenic storage device according to claim 10 wherein the pipe body further comprises a marking region.

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