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(54) **MICROFLUIDIC DEVICE AND METHOD FOR GENERATING A SKIN CONSTRUCT**

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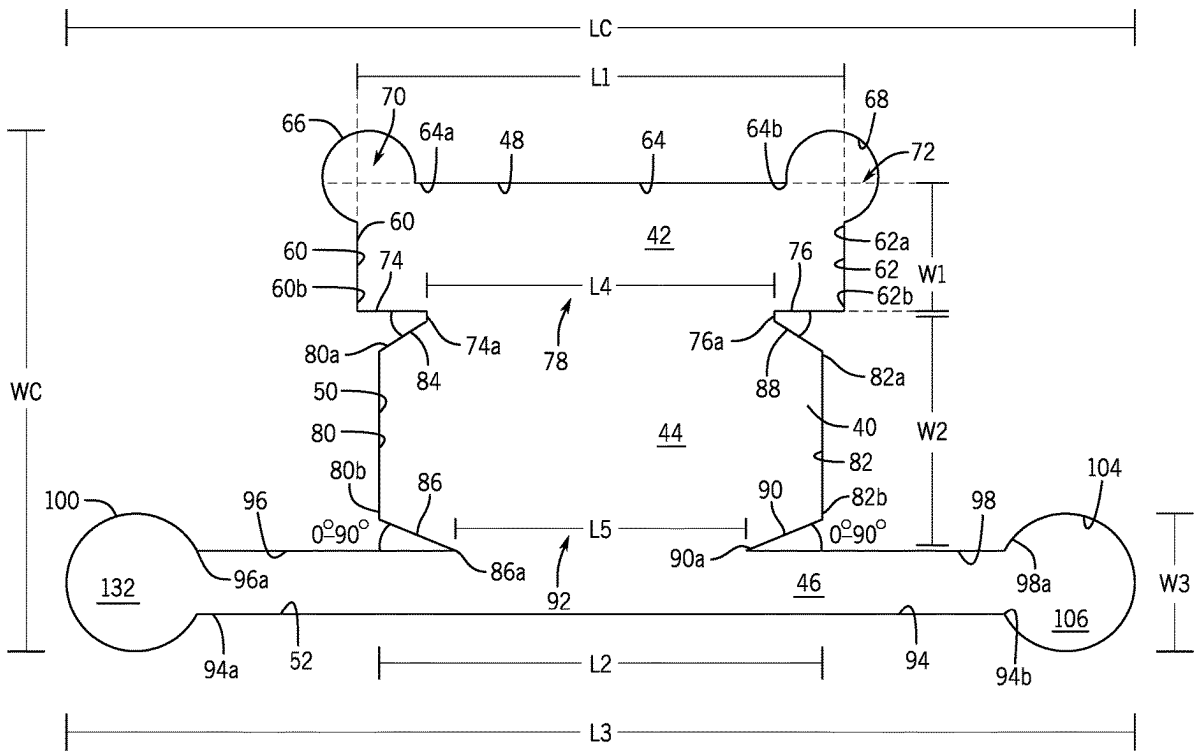
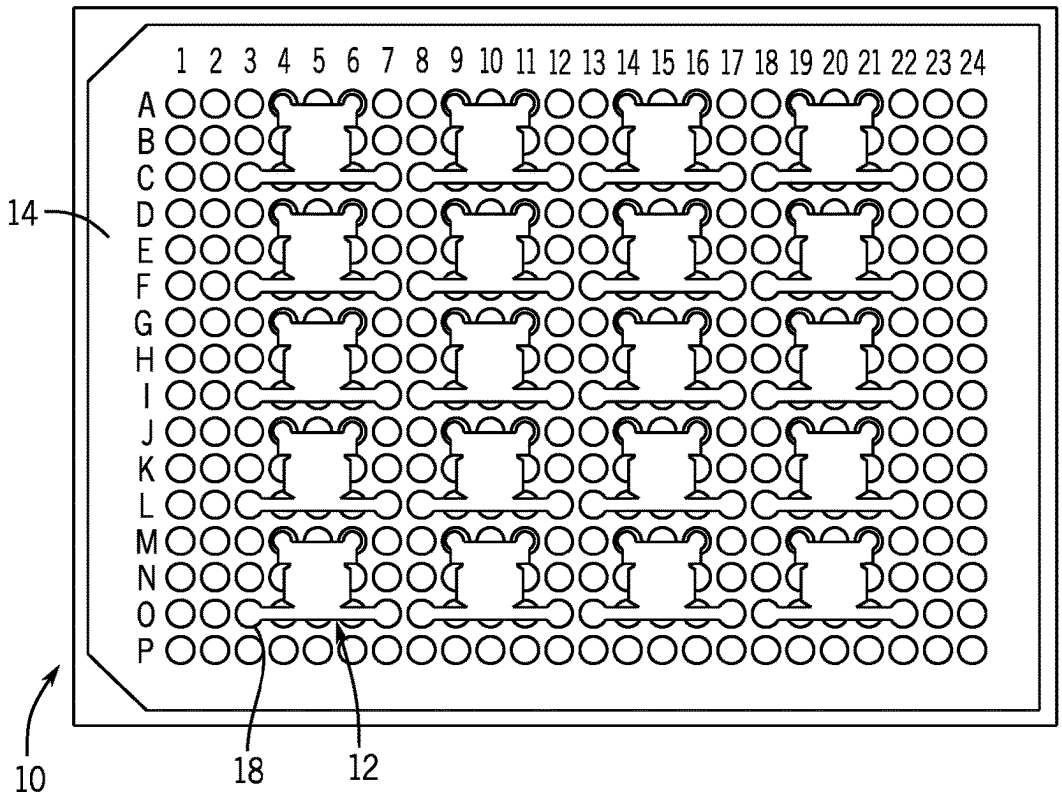
(57) **ABSTRACT**

A device and method are provided for generating a skin construct. The device includes a body having a chamber formed therein. The second portion of the chamber is filled with a polymerizable material and the material is allowed to polymerize within the second portion of the chamber. A cell media is deposited in the first portion of the chamber and a first portion of the cell media forms a skin construct on the polymerized material. The third portion of the chamber is filled with a media which contacts the polymerized material. A second portion of the cell media is removed from the first portion of the chamber such that ambient air in the first portion of the chamber forms an interface with the skin construct. The body may be rotated so as to allow the skin construct to be formed on the polymerized material and to be imaged with an imaging device.




1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
A
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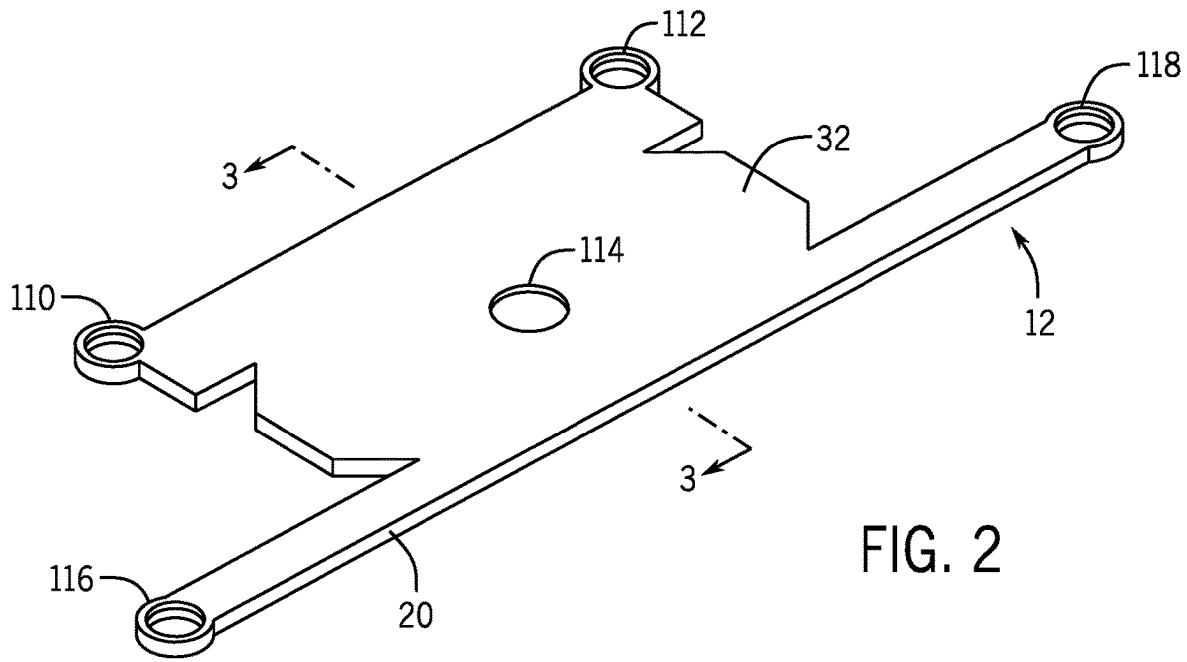
12

FIG. 1


112
118
32
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114
110
12
3
116
20

FIG. 2

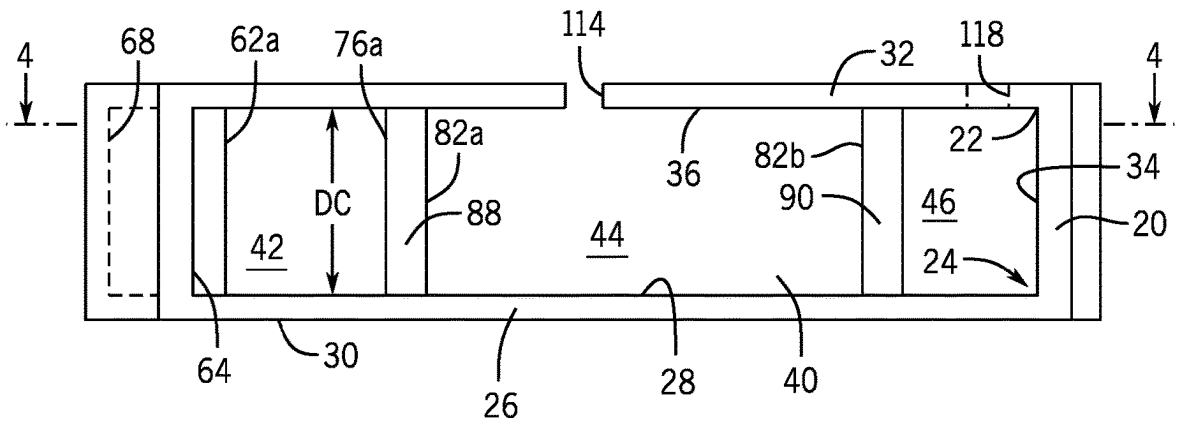
4
68
62a
76a
114
32
118
4
82a
36
82b
22
34
DC
88
90
46
20
42
44
24
64
30
26
28
40

FIG. 3

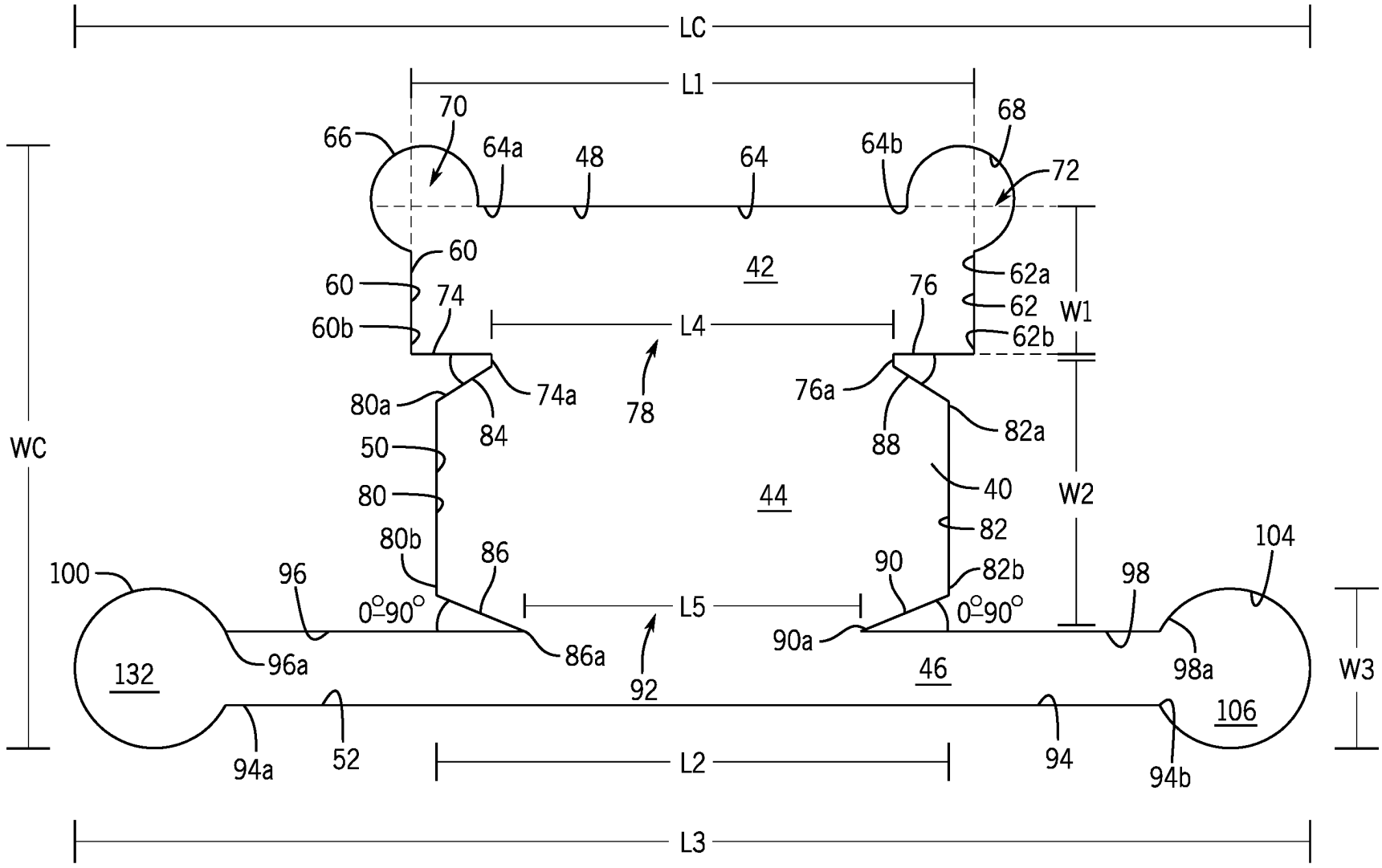
LC
L1
70
66
64a
48
64
64b
68
72
60
60
74
60b
42
62a
76
62
62b
W1
L4
80a
74a
78
76a
84
88
82a
WC
50
80
40
W2
44
82
80b
86
90
82b
104
100
96
0°-90°
L5
98
0°-90°
90a
86a
92
96a
132
46
98a
W3
106
94a
52
L2
94
94b
L3

FIG. 4

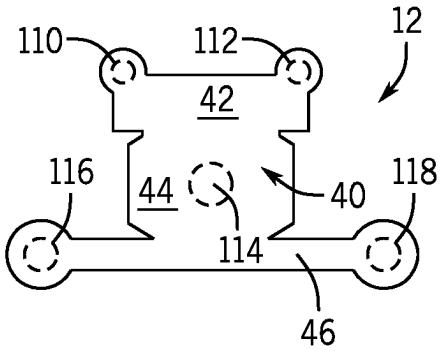

FIG. 5A

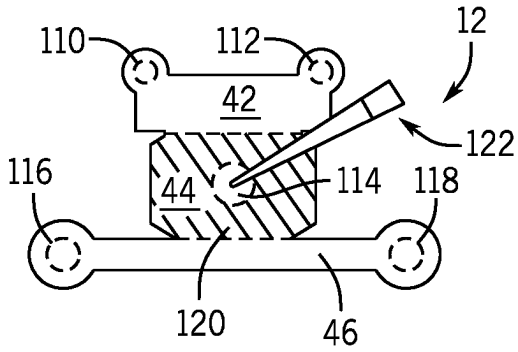

FIG. 5B

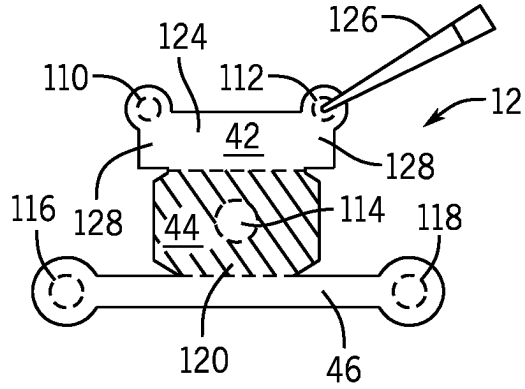

FIG. 5C

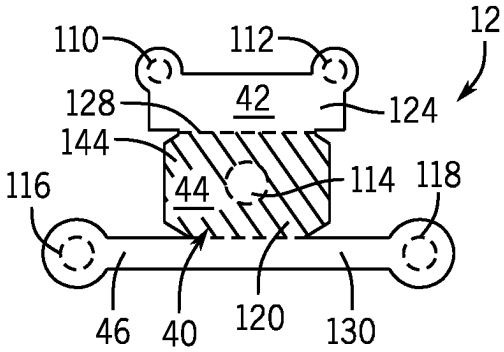

FIG. 5D

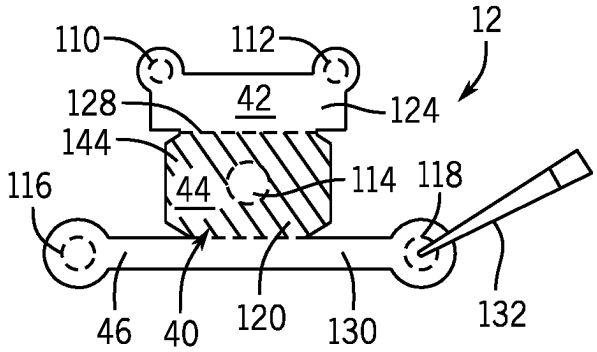

FIG. 5E

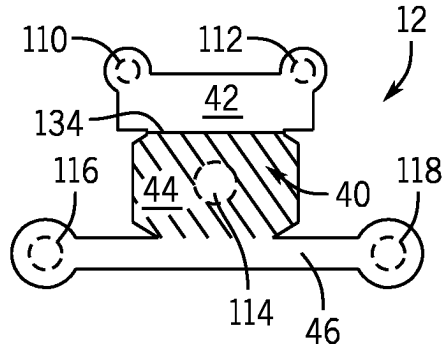

FIG. 5F

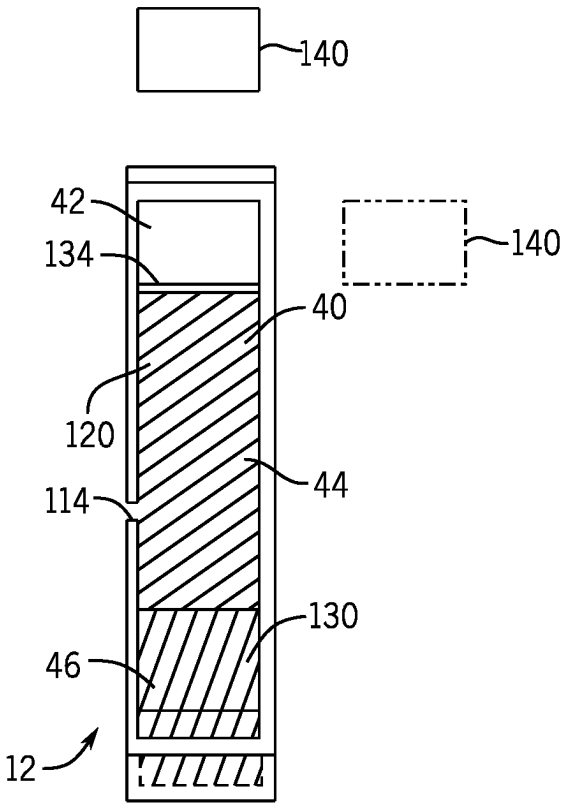

FIG. 6

MICROFLUIDIC DEVICE AND METHOD FOR GENERATING A SKIN CONSTRUCT

REFERENCE TO GOVERNMENT GRANT

[0001] This invention was made with government support under W81XWH-19-1-0478 awarded by the ARMY/MRDC and under AR066524 awarded by the National Institutes of Health. The government has certain rights in the invention.

FIELD OF THE INVENTION

[0002] This invention relates generally to microfluidic devices, and in particular, to a microfluidic device and method for generating a skin construct.

BACKGROUND AND SUMMARY OF THE INVENTION

[0003] Research into new therapies for skin diseases is challenging for a number of reasons. As is known, skin cells are exposed to both atmospheric air and liquids within the body. However, conventional cell culture models do not accurately mimic the in vivo conditions necessary for insuring the reliability, validity, and transferability of the research. As such, dermatology and pulmonary researchers have turned to air-liquid interface systems to allow the researchers to more accurately mimic in vivo conditions.

[0004] Typically, an air-liquid interface system utilizes a transwell plate having inserts positioned in each well. The insert divides each well in upper and lower compartments, which are separated by a porous filter support. The lower compartment is filled with a liquid media and cells are cultured on porous filter support. It can be appreciated that one side of the cell culture is continuously exposed to the liquid media in the second compartment, while the opposite side of the cell culture is surrounded by air. This arrangement, in turn, allows the researcher to produce a skin layer in an environment that more closely resembles in vivo conditions.

[0005] While functional for their intended purpose, these prior air-liquid interface systems have certain limitations. For example, air-liquid interface system utilizing transwell plates have a limited capacity for multiple assays due in part to the difficulty of extracting cells from them. Further, transwell plates are expensive to manufacture, the manufacturing process is slow, and the transwell plates do not allow for easy imaging in 3-dimensions. Consequently, there exists a need to provide an air-liquid interface system for generating optically transparent skin that is simple and inexpensive to manufacture and allows for easy 3-dimensional imaging.

[0006] Therefore, it is primary object and feature of the present invention to provide a microfluidic device and method for generating a skin construct.

[0007] It is a further object and feature of the present invention to provide a microfluidic device and method for generating a skin construct in an environment that more closely resembles in vivo conditions.

[0008] It is a still further object and feature of the present invention to provide a microfluidic device and method for generating a skin construct that is simple and inexpensive to manufacture and allows for easy 3-dimensional imaging.

[0009] In accordance with the present invention, a device is provided for generating a skin construct. The device includes a body having a chamber formed therein. The chamber is defined by opposing first and second surfaces interconnected and spaced by an inner surface. The chamber includes a first portion adapted for receiving a cell culture therein, a second portion adapted for receiving a polymerizable material therein and a third portion adapted for receiving a media therein. A first flow restriction projects from the inner surface between the first and second portions of the chamber. The first flow restriction is configured to discourage flow of polymerizable material from the second portion of the chamber to the first portion of the chamber. A second flow restriction projects from the inner surface between the second and third portions of the chamber. The second flow restriction is configured to discourage flow of polymerizable material from the second portion of the chamber to the third portion of the chamber. A cell port extends through the first surface and communicates with the first portion of the chamber. A material port extends through the first surface and communicates with the second portion of the chamber. A media port extends through the first surface and communicates with the third portion of the chamber. The first, second and third portions of the chamber have corresponding lengths. The length of the second portion of the chamber is less than the length of the first portion of the chamber. Similarly, the length of the second portion of the chamber is less than the length of the third portion of the chamber.

[0010] The first flow restriction is defined by first and second projections extending from the inner surface towards each other and being spaced by a length. The length between the first and second projections is less than the length of the second chamber. Similarly, the second flow restriction is defined by first and second projections extending from the inner surface towards each other and being spaced by a length. The length between the first and second projections of the second flow restriction is less than the length of the second chamber.

[0011] The first, second and third portions of the chamber also have corresponding widths. The width of the second portion of the chamber is greater than the width of the first portion of the chamber. In addition, the width of the second portion of the chamber is greater than the width of the third portion of the chamber.

[0012] In accordance with a further aspect of the present invention, a method is provided for generating a skin construct. The method includes the step of providing a chamber in a body. The chamber has first, second and third portions. The second portion of the chamber is filed with a polymerizable material and the material is allowed to polymerize within the second portion of the chamber. A cell media is deposited in the first portion of the chamber. A first portion of the cell media forms a skin construct on the polymerized material. The third portion of the chamber is filed with a media. The media contacts the polymerized material.

[0013] A second portion of the cell media is removed from the first portion of the chamber such that ambient air in the first portion of the chamber forms an interface with the skin construct. A flow of polymerizable material into the first portion of the chamber as the second chamber is filled with the polymerizable material is discouraged and a flow of polymerizable material into the third portion of the chamber as the second chamber is filled with the polymerizable material is discouraged.

[0014] In accordance with a still further aspect of the present invention, a method is provided for generating and

imaging a skin construct. The method includes the step of providing a chamber in a body. The chamber is defined between a first wall and a second wall, and has first, second and third portions. The body is orientated such that the second wall lies in a generally horizontal plane. The second portion of the chamber is filled with a polymerizable material and the material is allowed to polymerize within the second portion of the chamber. A cell media is deposited in the first portion of the chamber and the body is rotated such that the first and second wall lie in generally vertical planes. A first portion of the cell media forms a skin construct on the polymerized material. The third portion of the chamber is filled with a media. The media contacts the polymerized material. A second portion of the cell media is removed from the first portion of the chamber such that ambient air in the first portion of the chamber forms an interface with the skin construct. The skin construct is imaged with an imaging device.

[0015] The body includes a cell port extending through the first wall and communicating with the first portion of the chamber. A material port extends through the first surface and communicates with the second portion of the chamber. A media port extends through the first surface and communicates with the third portion of the chamber. It is contemplated to discourage a flow of polymerizable material in the first portion of the chamber as the second chamber is filled with the polymerizable material and to discourage a flow of polymerizable material in the third portion of the chamber as the second chamber is filled with the polymerizable material. More specifically, the body may include at least one projection extending into chamber. The at least one projection discourages the flow of polymerizable material into the first portion of the chamber as the second chamber is filled with the polymerizable material. In addition, the at least one projection discourages the flow of polymerizable material into the third portion of the chamber as the second chamber is filed with the polymerizable material.

[0016] The first, second and third portions of the chamber have corresponding lengths. The length of the second portion of the chamber is less than the length of the first portion of the chamber. Similarly, the length of the second portion of the chamber is less than the length of the third portion of the chamber. In addition, the first, second and third portions of the chamber have corresponding widths. The width of the second portion of the chamber is greater than the width of the first portion of the chamber and the width of the second portion of the chamber is greater than the width of the third portion of the chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The drawings furnished herewith illustrate a preferred construction of the present invention in which the above advantages and features are clearly disclosed as well as others which will be readily understood from the following description of the illustrated embodiment.

[0018] In the drawings:

[0019] FIG. **1** is a top plan view of well plate including a microfluidic device in accordance with the present invention;

[0020] FIG. **2** is an isometric view of a microfluidic device in accordance with the present invention;

[0021] FIG. **3** is a cross-sectional view of the microfluidic device of the present invention taken along line **3-3** of FIG. **2**;

[0022] FIG. **4** is a cross-sectional view of the microfluidic device of the present invention taken along line **4-4** of FIG. **3**;

[0023] FIG. **5**A is a cross-sectional view, similar to FIG. **4**, showing an initial step for effectuating the methodology of the present invention;

[0024] FIG. **5**B is a cross-sectional view of the microfluidic device, similar to FIG. **5**A, showing a subsequent step for effectuating the methodology of the present invention;

[0025] FIG. **5**C is a cross-sectional view of the microfluidic device, similar to FIG. **5**B, showing a further step for effectuating the methodology of the present invention;

[0026] FIG. **5**D is a cross-sectional view of the microfluidic device, similar to FIG. **5**C, showing a still further step for effectuating the methodology of the present invention;

[0027] FIG. **5**E is a cross-sectional view of the microfluidic device, similar to FIG. **5**D, showing a still further step for effectuating the methodology of the present invention;

[0028] FIG. **5**F is a cross-sectional view of the microfluidic device, similar to FIG. **5**E, showing a still further step for effectuating the methodology of the present invention; and

[0029] FIG. **6** is a cross-sectional view of the microfluidic device of the present invention, similar to FIG. **3**, showing a skin construct fabricated in the microfluidic device.

DETAILED DESCRIPTION OF THE DRAWINGS

[0030] Referring to FIG. **1**, a well plate adapted for receiving a plurality of microfluidic devices for generating a skin construct is generally designated by the reference numeral **10**. It is contemplated for well-plate **10** to include a predetermined number of microfluidic devices **12** formed in outer surface **14** thereof. In the depicted embodiment, well plate **10** includes twenty (20) microfluidic devices arranged in rows and columns, however, microfluidic devices **12** in well plate **10** may be arrange in a different configurations and the well plate **10** may include any number of microfluidic devices **12** therein without deviating from the scope of the present invention. As hereinafter described, microfluidic devices **12** are identical in structure, and as such, the description of microfluidic device **12** hereinafter provided is intended to fully describe each of the microfluidic devices **12** formed in well plate **10**, as if fully described herein.

[0031] It is contemplated for microfluidic devices **12** to be fabricated within well plate **10** or may be fabricated individually and deposited within a corresponding well **18** in outer surface **14** of well plate **10**. Referring to FIGS. **2-4**, each microfluidic device **12** is defined by outer wall **20** having upper and lower ends **22** and **24**, respectively. Outer wall **20** may be of uniform thickness or have varying thicknesses without deviating from the scope of the present invention. Lower end **24** of outer wall **20** of microfluidic device **12** is closed by end wall **26** having inner and outer surfaces **28** and **30**, respectively. It is contemplated for end wall **26** to be removably connected to lower end **24** of outer wall **20** of microfluidic device **12** to facilitate access to the interior of microfluidic device **12**.

[0032] Access wall **32** extends radially inward from inner surface **34** of outer wall **20** adjacent upper end **22** thereof and lies in a place generally parallel to end wall **26**. Inner surface **36** of access wall **32**, inner surface **28** of end wall **26**, and inner surface **34** of outer wall **20** define chamber **40** therebetween. As hereinafter described, chamber **40** is

defined by first portion **42** adapted for receiving a cell culture therein, second portion **44** adapted for receiving a polymerizable material, e.g. a hydrogel, therein and third portion **46** adapted for receiving a media, e.g. a growth media or nutrients, therein. As best seen in FIG. **4**, first portion **42** of chamber **40** is defined by corresponding first portion **48** of inner surface **34** of outer wall **20**, second portion **44** of chamber **40** is defined by corresponding second portion **50** of inner surface **34** of outer wall **20**, and third portion **46** of chamber **40** is defined by corresponding third portion **52** of inner surface **34** of outer wall **20**.

[0033] Referring to FIGS. **3-4**, chamber **40** has a depth DC in the range of 0.1 millimeters (mm) to 1 mm; an overall length LC, preferably, in the range of 5 mm to 20 mm; and an overall width WC, preferably, in the range 1.2 mm to 5 mm. Depth DC of chamber **40** ensures the skin construct to be formed, FIGS. **5**F and **6**, has adequate surface area to provide an air-liquid interface, as hereinafter described. First, second and third portions **42**, **44** and **46**, respectively, of chamber **40** have corresponding lengths L1, L2 and L3, respectively, and corresponding widths W1, W2 and W3, respectively. Preferably, length L2 of second portion **44** of chamber **40** is less than length L1 of first portion **42** of chamber **40** and length L2 of second portion **44** of chamber **40** is less than length L3 of third portion **46** of chamber **40**. By way of example, length L1 of first portion **42** of chamber **40** is in the range of 2 mm to 15 mm; length L2 of second portion **44** of chamber **40** is in the range of 2 mm to 10 mm; and length L3 of third portion **46** of chamber **40** is in the range of 5 mm to 20 mm. Lengths L1, L2 and L3 of first, second and third portions **42**, **44** and **46**, respectively, of chamber **40** are broadly selected to recapitulate physiology of human skin, as hereinafter described.

[0034] It is contemplated for width W2 of second portion **44** of chamber **40** is greater than width W1 of first portion **42** of chamber **40** and width W2 of second portion **44** of chamber **40** is less than width W3 of third portion **46** of chamber **40**. By way of example, width W1 of first portion **42** of chamber **40** is in the range of 0.25 mm to 2 mm; width W2 of second portion **44** of chamber **40** is in the range of 0.6 mm to 3 mm; and width W3 of third portion **46** of chamber **40** is in the range of 0.25 mm to 2 mm. Widths W1, W2 and W3 of first, second and third portions **42**, **44** and **46**, respectively, of chamber **40** are selected to maximize surface area for cell adherence and nutrient diffusion, as hereinafter described.

[0035] First portion **48** of inner surface **34** of outer wall **20** includes opposing, first and second end faces **60** and **62**, respectively, which are generally parallel. First end face **60** extends between first and second terminal edges **60***a* and **60***b*, respectively. Similarly, second end face **62** extends between first and second terminal edges **62***a* and **62***b*, respectively. Side face **64** is generally perpendicular to first and second end faces **60** and **62**, respectively, and terminates at first and second terminal edges **64***a* and **64***b*, respectively. First arcuate face **66** extends between first terminal edge **60***a* of first end face **60** and first terminal edge **64***a* of side face **64** so as to define cell port **70** of first portion **42** of chamber **40**. Second arcuate face **68** extends between first terminal edge **62***a* of second end face **62** and second terminal edge **64***b* of side face **64** so as to define cell port **72** of first portion **42** of chamber **40**.

[0036] First portion **48** of inner surface **34** of outer wall **20** further includes first and second restriction faces **74** and **76**, respectively, which lie in a common plane generally parallel to and spaced from side face **64**. More specifically, first restriction face **74** projects from second terminal edge **60***b* of first end face **60** and second restriction face **76** projects from second terminal edge **62***b* of second end face **62**. Terminal edges **74***a* and **76***a* of first and second restriction faces **74** and **76**, respectively, define an opening **78** between first and second portions **42** and **44**, respectively, of chamber **40** so as to allow communication therebetween. Opening **78** has a length L4 less than length L2 of second portion **44** of chamber **40**, and preferably, in the range of 2 mm to 15 mm, such that first and second restriction faces **74** and **76**, respectively, act as pinning features to ensure polymerizable material received in second portion **44** of chamber **40** is constrained therein and does not invade first portion **42** of chamber **40**, as hereinafter described.

[0037] Second portion **50** of inner surface **34** of outer wall **20** includes opposing, first and second end faces **80** and **82**, respectively, which are generally parallel to each other. First end face **80** extends between first and second terminal edges **80***a* and **80***b*, respectively. Similarly, second end face **82** extends between first and second terminal edges **82***a* and **82***b*, respectively. Angular faces **84** and **86**, respectively, project from corresponding first and second terminal edges **80***a* and **80***b*, respectively, of first end face **80** and diverge from each other. Angular face **84** terminates at and intersects terminal edge **74***a* of first restriction face **74**. It can be understood that angular face **84** and first restriction face **74** define an acute angle therebetween. Angular face **86** terminates at terminal edge **86***a*.

[0038] Angular faces **88** and **90**, respectively, project from corresponding first and second terminal edges **82***a* and **82***b*, respectively, of second end face **82** and diverge from each other. Angular face **88** terminates at terminal edge **76***a* of second restriction face **76**. It can be understood that angular face **88** and second restriction face **76** define an acute angle therebetween. Angular face **90** terminates at terminal edge **90***a*. Terminal edges **88***a* and **90***a* of angular faces **88** and **90**, respectively, define an opening **92** between second and third portions **44** and **46**, respectively, of chamber **40** so as to allow communication therebetween.

[0039] Third portion **52** of inner surface **34** of outer wall **20** includes side face **94** which is generally parallel to side face **64** and terminates at first and second terminal edges **94***a* and **94***b*, respectively. Third portion **52** of inner surface **34** of outer wall **20** further includes first and second restriction faces **96** and **98**, respectively, which lie in a common plane and generally parallel to and spaced from side face **94**. More specifically, first restriction face **96** projects from terminal edge **88***a* of angular face **88** and terminates at terminal edge **96***a*. Second restriction face **98** projects from terminal edge **90***a* of angular face **90** and terminal edge **98***a*. Opening **92** has a length L5 less than length L3 of third portion **46** of chamber **40**, and preferably, in the range of 2 mm to 15 mm, such that first and second restriction faces **96** and **98**, respectively, act as pinning features to ensure polymerizable material received in second portion **44** of chamber **40** is constrained therein and does not invade third portion **46** of chamber **40**.

[0040] First arcuate face **100** extends between first terminal edge **94***a* of side face **94** and terminal edge **96***a* of first restriction face **96** so as to define media port **102** of third portion **46** of chamber **40**. Second arcuate face **104** extends between second terminal edge **94***b* of side face **94** and

terminal edge **98***a* of second restriction face **98** so as to define media port **106** of third portion **46** of chamber **40**.

[0041] Referring to FIG. **2**, access wall **32** includes apertures **110** and **112**, respectively, which are axially aligned with and communicate with corresponding first and second cell ports **70** and **72**, respectively, of first portion **42** of chamber **40**. Media port or aperture **114** extends through access wall **32** and communicates with second portion **44** of chamber **40**. Apertures **116** and **118**, respectively, which are axially aligned with and communicate with corresponding media ports **102** and **106**, respectively, of third portion **46** of chamber **40**. It is contemplated for apertures **110**, **112**, **114**, **116**, and **118** to have diameters in the range of 0.1 mm to 2 mm to ensure ease of loading of first, second, and third portions **42**, **44** and **46**, respectively, of chamber **40**, as hereinafter described.

[0042] Referring to FIGS. **5**A-**5**F, in operation, microfluidic device **12** (or well-plate **10** housing microfluidic device **12**) is positioned such that end wall **26** is lies in a generally horizontal plane, FIG. **5**A. Polymerizable material **120** is loaded into second portion **44** of chamber **40** through aperture **114** in access wall **32** in any conventional matter, for example, using pipette **122**, FIG. **5**B. As noted above, first and second restriction faces **74** and **76**, respectively, act as pinning features to ensure polymerizable material **120** received in second portion **44** of chamber **40** is constrained therein and does not invade first portion **42** of chamber **40**. Similarly, first and second restriction faces **96** and **98**, respectively, act as pinning features to ensure polymerizable material **20** received in second portion **44** of chamber **40** is constrained therein and does not invade third portion **46** of chamber **40**.

[0043] After a time period, e.g. fifteen (15) minutes, polymerizable material **120** received in second portion **44** of chamber **40** polymerizes. Once polymerizable material **120** received in second portion **44** of chamber **40** is polymerized, cell culture **124** is loaded into first portion **42** of chamber **40** at least one of apertures **110** and **112**, respectively, (e.g., aperture **112**) through access wall **32**, in any conventional matter, for example, using pipette **126**, FIG. **5**C. Once cell culture **124** is loaded into first portion **42** of chamber **40**, microfluidic device **12** is rotated 90 degrees such that end wall **26** of microfluidic device **12** is lies in a generally vertical plane, FIG. **5**D. It can be appreciated that cell culture **124** contacts polymerized material **120** through opening **78** between first and second portions **42** and **44**, respectively, of chamber **40**. Cells **128** in cell culture **124** are allowed to settle and adhere to polymerizable material **120**.

[0044] As cells **128** in cell culture **124** settle and adhere to polymerizable material **120**, media **130** is loaded into third portion **46** of chamber **40** through at least one of apertures **116** and **118**, respectively, in access wall **32**, in any conventional matter, for example, using pipette **132**, FIG. **5**E. With media **130** in third portion **46** of chamber **40**, It can be appreciated understood that media **130** in third portion **46** of chamber **40** contacts polymerized material **120** in second portion **44** of chamber **40** through opening **92** between second and third portions **44** and **46**, respectively, of chamber **40**. Media **130** then permeates polymerized material **120**, for reasons hereinafter described.

[0045] Once cells **128** in cell culture **124** settle and adhere to polymerized material **120**, a layer or skin construct **134** of cells **128** is formed along the intersection of cell culture **124** and polymerizable material **120**. Thereafter, cell culture **124** in first portion **42** of chamber **40** is removed therefrom, e.g. using a vacuum or the like, thereby establishing an air interface between skin construct **134** and the environment within first portion **42** of chamber **40**. Similarly, media **130** permeating polymerized material **120** communicates with skin construct **134** through opening **78** between first and second portions **42** and **44**, respectively, of chamber **40**, thereby forming a liquid interface between skin construct **134** and media **130** permeating polymerized material **120** in second portion **44** of chamber **40**.

[0046] As described, it can be appreciated that one side of skin construct **134** is continuously exposed to media in the second portion of **44** of chamber **40**, while the opposite side of skin construct **134** is surrounded by air. This arrangement, in turn, provides a researcher with an environment for skin construct **134** that more closely resembles in vivo conditions. Thereafter, image device **140** may be used to image skin construct **134** from various locations to allow a user to consider the effects of the media on skin construct **134**.

[0047] Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter that is regarded as the invention.

We claim:

1. A device for generating a skin construct, comprising

a body including:

a chamber formed therein and being defined by opposing first and second surfaces interconnected and spaced by an inner surface, the chamber including a first portion adapted for receiving a cell culture therein, a second portion adapted for receiving a polymerizable material therein and a third portion adapted for receiving a media therein;

a first flow restriction projecting from the inner surface between the first and second portions of the chamber, the first flow restriction configured to discourage flow of polymerizable material from the second portion of the chamber to the first portion of the chamber; and

a second flow restriction projecting from the inner surface between the second and third portions of the chamber, the second flow restriction configured to discourage flow of polymerizable material from the second portion of the chamber to the third portion of the chamber.

2. The device of claim **1** further comprising a cell port extending through the first surface and communicating with the first portion of the chamber.

3. The device of claim **1** further comprising a material port extending through the first surface and communicating with the second portion of the chamber.

4. The device of claim **1** further comprising a media port extending through the first surface and communicating with the third portion of the chamber.

5. The device of claim **1** wherein the first, second and third portions of the chamber have corresponding lengths, the length of the second portion of the chamber being less than the length of the first portion of the chamber.

6. The device of claim **1** wherein the first, second and third portions of the chamber have corresponding lengths, the length of the second portion of the chamber being less than the length of the third portion of the chamber.

7. The device of claim **5** wherein the first flow restriction is defined by first and second projections extending from the

inner surface towards each other and being spaced by a length, the length between the first and second projections being less than the length of the second chamber.

8. The device of claim **7** wherein the second flow restriction is defined by first and second projections extending from the inner surface towards each other and being spaced by a length, the length between the first and second projections of the second flow restriction being less than the length of the second chamber.

9. The device of claim **1** wherein the first, second and third portions of the chamber have corresponding widths, the width of the second portion of the chamber being greater than the width of the first portion of the chamber.

10. The device of claim **1** wherein the first, second and third portions of the chamber have corresponding widths, the width of the second portion of the chamber being greater than the width of the third portion of the chamber.

11. A method for generating a skin construct, comprising the steps of:

providing a chamber in a body, the chamber having first, second and third portions;

filing the second portion of the chamber with a polymerizable material and allowing the material to polymerize within the second portion of the chamber;

depositing a cell media in the first portion of the chamber, a first portion of the cell media forming a skin construct on the polymerized material; and

filling the third portion of the chamber with a media, the media contacting the polymerized material.

11. The method of claim **10** comprising the additional step of removing a second portion of the cell media from the first portion of the chamber such that ambient air in the first portion of the chamber forms an interface with the skin construct.

12. The method of claim **10** comprising the additional step of discouraging a flow of polymerizable material into the first portion of the chamber as the second chamber is filled with the polymerizable material.

13. The method of claim **12** comprising the additional step of discouraging a flow of polymerizable material into the third portion of the chamber as the second chamber is filled with the polymerizable material.

14. A method for generating and imaging a skin construct, comprising the steps of:

providing a chamber in a body, the chamber defined between a first wall and a second wall and having first, second and third portions;

orientating the body such that the second wall lies in a generally horizontal plane;

filing the second portion of the chamber with a polymerizable material and allowing the material to polymerize within the second portion of the chamber;

depositing a cell media in the first portion of the chamber and rotating the body such that the first and second wall lie in generally vertical planes whereby a first portion of the cell media forming a skin construct on the polymerized material;

filling the third portion of the chamber with a media, the media contacting the polymerized material;

removing a second portion of the cell media from the first portion of the chamber such that ambient air in the first portion of the chamber forms an interface with the skin construct; and

imaging the skin construct with an imaging device.

15. The method of claim **14** wherein the body includes:

a cell port extending through the first wall and communicating with the first portion of the chamber;

a material port extending through the first surface and communicating with the second portion of the chamber; and

a media port extending through the first surface and communicating with the third portion of the chamber.

16. The method of claim **14** comprising the additional step of discouraging a flow of polymerizable material in the first portion of the chamber as the second chamber is filled with the polymerizable material.

17. The method of claim **16** comprising the additional step of discouraging a flow of polymerizable material in the third portion of the chamber as the second chamber is filled with the polymerizable material.

18. The method of claim **14** wherein the first, second and third portions of the chamber have corresponding lengths, the length of the second portion of the chamber being less than the length of the first portion of the chamber.

19. The method of claim **14** wherein the first, second and third portions of the chamber have corresponding lengths, the length of the second portion of the chamber being less than the length of the third portion of the chamber.

20. The method of claim **14** wherein the body includes at least one projection extending into chamber, the at least one projection discouraging a flow of polymerizable material into the first portion of the chamber as the second chamber is filled with the polymerizable material.

21. The method of claim **14** wherein the body includes at least one projection extending into chamber, the at least one projection discouraging a flow of polymerizable material into the third portion of the chamber as the second chamber is filed with the polymerizable material.

22. The method of claim **14** wherein the first, second and third portions of the chamber have corresponding widths, the width of the second portion of the chamber being greater than the width of the first portion of the chamber.

23. The method of claim **14** wherein the first, second and third portions of the chamber have corresponding widths, the width of the second portion of the chamber being greater than the width of the third portion of the chamber.

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