CLAIMS

1. An apparatus for culturing cells or tissue, the apparatus comprising

a container comprising a first endwall (bottom), and at least one sidewall, a detachable second endwall (top) adapted to engage with the container to define a chamber, and

a scaffold adapted to receive a substrate for cells to reside upon, wherein at least a part of at least one of the first endwall (bottom), the at least one sidewall, or the second endwall (top) comprises a gas permeable material or is adapted to engage with a gas permeable material and is perforated to allow gaseous exchange; and

wherein the apparatus is configurable between (a) a first mode in which the substrate is not disposed in gaseous communication with a gas permeable material, and (b) a second mode in which the substrate is moved to be disposed in gaseous communication with a gas permeable material, in particular in contact therewith said gas permeable material.

2. An apparatus for culturing cells or tissue according to claim 1, wherein at least a part of the bottom comprises a gas permeable material or is adapted to engage with a gas permeable material and is perforated to allow gaseous exchange;

wherein at least a part of the second endwall (top) or at least a part of the at least one sidewall comprises a gas permeable material or is adapted to engage with a gas permeable material and is perforated to allow gaseous exchange; and

wherein the scaffold engages with the at least one sidewall to (a) allow substantially linear movement of the scaffold at least partway between the first endwall (bottom) of the chamber and the second endwall (top), and restrict rotation or inversion of the scaffold about an axis perpendicular to the at least one sidewall, or (b) allow rotational movement of the scaffold about an axis perpendicular to the at least one sidewall.

3. An apparatus for culturing cells or tissue according to claim 1, wherein at least a part of the bottom comprises a gas permeable material or is adapted to engage with a gas permeable material and is perforated to allow gaseous exchange;

wherein at least a part of the top comprises a gas permeable material or is adapted to engage with a gas permeable material and is perforated to allow gaseous exchange; and

wherein the scaffold engages with the at least one sidewall to (a) allow substantially linear movement of the scaffold at least partway between the

bottom of the chamber and the top, and (b) restrict rotation or inversion of the scaffold about an axis perpendicular to the at least one sidewall.

4. An apparatus according to any one of claims 1 to 3 wherein when in use, and a gas permeable material is present in both the bottom and the top, the chamber is liquidly sealable from, but in gaseous communication with, the environment.

5. An apparatus according to any one of claims 1 to 4 wherein the gas permeable material is a gas permeable membrane.

6. An apparatus according to any one of claims 1 to 5 wherein gas permeable material is polydimethylsiloxane.

7. An apparatus according to any one of claims 1 to 6 wherein the scaffold receives the substrate to present culturing surfaces on opposite planar sides of the substrate.

8. An apparatus according to any one of claims 1 to 7 wherein the substrate is a biocompatible material, such as a biocompatible membrane.

9. An apparatus according to any one of claims 1 to 8 wherein the substrate is gas permeable.

10. An apparatus according to any one of claims 1 to 8 wherein the substrate is gas-impermeable.

11. An apparatus according to any one of claims 1 to 8 wherein the substrate is or comprises poly(lactic co-glycolic acid) (PLGA).

12. An apparatus according to claim 11 wherein the substrate is or comprises electrospun PLGA.

13. An apparatus according to any one of claims 1 to 12 wherein the substrate comprises a surface treated to improve cell adhesion, cell migration, or tissue stratification.

14. An apparatus according to any one of claims 1 to 13, wherein the scaffold comprises

a frame defining an interior perimeter and an exterior perimeter, said frame comprising a substantially planar upper surface, a substrate for cells to reside upon held in a substantially planar arrangement across the interior perimeter of the frame, wherein the scaffold is configured to bring substantially all of the substrate or the cells or tissues present on the substrate into contact with a gas permeable interface when the scaffold is placed in the apparatus comprising at least one gas permeable interface.

15. An apparatus according to any one of claims 1 to 13, wherein the scaffold comprises

a first frame defining an interior perimeter and an exterior perimeter, said first frame comprising a substantially planar upper surface, a second frame defining an interior perimeter and an exterior perimeter, said second frame comprising a substantially planar upper surface, wherein the first frame and the second frame detachably engage around at least a part of their perimeters to define an interface to receive and hold the substrate, wherein when held the substrate is held in a substantially planar arrangement across the interior perimeter of the first frame, and wherein when engaged, the upper surface of the first frame and the upper surface of the second frame are substantially co-planar.

16. The apparatus according to claim 15 wherein the dimensions of the interior perimeter of the second frame at its upper surface are greater than the dimensions of the exterior perimeter of the first frame at its upper surface, such that the second frame engages around the exterior perimeter of the first frame at at least the upper surface of the first frame.

17. The apparatus according to claim 15 or 16 wherein the substrate is held in a substantially planar arrangement across the interior perimeter of the scaffold at the upper surface of the first frame, thereby to allow direct contact of the upper surface of the substrate with, for example, a gas permeable interface.

18. The apparatus according to any one of claims 15 to 17 wherein the substrate is held between the first frame and the second frame by friction fit engagement of the first frame to the second frame.

19. The apparatus according to claim 18 wherein the friction fit engagement is such that it rigidly clamps the substrate to maintain the substrate in a substantially planar arrangement across the interior perimeter of the scaffold.

20. The apparatus according to any one of claims 15 to 17 wherein the substrate is held between the first frame and the second frame at least in part by one or more protrusions extending between the first frame and the second frame.

21. The apparatus according to claims 14 or 15 wherein the lower surface of the scaffold comprises at least one section spanning the exterior perimeter of the scaffold and the adjacent interior perimeter, said section having a lower surface which is raised towards the upper surface of the scaffold, wherein said section defines a void when the scaffold is placed on a flat surface.

22. The apparatus according to claim 21 wherein the section defines a recess provided to allow for easy removal of air bubbles when the scaffold is in submerged culture.

23. The apparatus according to any one of claims 14 to 22 wherein the dimensions of the interior perimeter of the scaffold at its upper surface are greater than the dimensions of one or more of the gas permeable interfaces into contact with which the substrate or the cells or tissues present on the substrate held by the scaffold is/are to be brought, such that substantially all of the substrate or the cells or tissues present on the substrate is/are capable of contacting the gas permeable interface.

24. The apparatus according to any one of claims 14 to 23 wherein the scaffold comprises one or more transverse members spanning the interior perimeter to provide support for the substrate.

25. A method for culturing stratified epidermal tissue or full thickness skin tissue, the method comprising the steps of:

a) providing a suspension comprising keratinocytes and fibroblasts in an amount of tissue culture medium sufficient to support cell growth;

b) introducing the suspension into a cell culture apparatus, wherein the apparatus comprises a container comprising a first endwall (bottom), at least one sidewall, and a detachable second endwall (top) adapted to engage with the container to define a chamber, and a scaffold adapted to receive a substrate for cells to reside upon,
wherein at least a part of the first endwall (bottom), the at least one sidewall, or the second endwall (top) comprises a gas permeable material or is adapted to engage with a gas permeable material and is perforated to allow gaseous exchange; and
wherein the apparatus is in a first mode in which the substrate is submerged in the suspension and is not in gaseous communication with a gas permeable material,

c) incubating the cell culture apparatus containing the suspension for a time sufficient for at least some of the keratinocytes and/or fibroblasts to adhere to the substrate,

d) adapting the cell culture apparatus to a second mode in which the substrate is and/or the cells are disposed in gaseous communication with the gas permeable material, and

e) incubating the cell culture apparatus for a time sufficient to allow epidermal stratification to occur.

26. Tissue prepared by a method according to claim 25.

27. Tissue according to claim 26 comprising a dermal layer comprising fibroblasts, a stratified epidermal layer comprising keratinocytes and a biocompatible substrate.

28. The tissue prepared in a method according to any one of claims 26 to 28 for use in the treatment of tissue damage in a subject in need thereof.

29. The tissue according to claim 31, wherein the treatment is of a wound, a burn, a scar or a surgical scar.

30. Use of a tissue prepared in a method according to any one of claims 26 to 29 in the manufacture of a medicament for use in the treatment of tissue damage in a subject in need thereof.

31. Use according to claim 30, wherein the treatment is one of a wound, a burn, a scar or a surgical scar.

32. A method of engineering a structure comprising epithelial tissue, the method comprising the steps of

a) providing an apparatus according to any one of claims 1 to 24 in which tissue has been grown, or providing an apparatus in which tissue has been grown according to a method of claim 25,

b) recovering under sterile conditions the tissue from the apparatus,

c) applying the tissue to the subject, and

d) manipulating the tissue to form the structure.

33. The method according to claim 32 wherein the tissue is epithelial tissue, stratified epithelial tissue, epidermis, or stratified epidermis.

34. The method according to claim 32 or 33 wherein the structure comprises a duct of the submandibular gland, attached gingiva, dorsum of tongue, hard palate, oesophagus, stomach, large intestine, small intestine, rectum, anus, gallbladder, thyroid follicle, skin, sweat gland duct, mesothelium of body cavities, ovary, fallopian tube, uterus, cervix, vagina, labia majora, tubuli recti, rete testis, ductuli efferentes, epididymis, vas deferens, ejaculatory duct, bulbourethral gland, seminal vesicle, oropharynx, larynx, larynx, vocal cord, trachea, respiratory bronchiole, cornea, nose, proximal convoluted tubule of the kidney, ascending thin limb of the kidney, distal convoluted tubule of the kidney, collecting duct of

the kidney, renal pelvis, ureter, urinary bladder, prostatic urethra, membranous urethra, penile urethra, or external urethral orifice.