CLAIMS

[Claim 1]

A membrane separation culture device comprising:

an upper structure constituted with a vessel in which at least a portion of the bottom thereof is formed with a separation membrane having pores that allow stem cells to permeate therethrough; and

a lower structure constituted with a vessel that retains a fluid in which the membrane of the upper structure is immersed.

~~[Claim 2]~~

~~The membrane separation culture device according to claim 1~~, wherein

the separation membrane comprises:

a base material membrane consisting of a hydrophobic polymer; and

a functional layer formed by allowing one or more hydrophilic polymers selected from a vinyl pyrrolidone polymer, a polyethylene glycol polymer and a vinyl alcohol polymer to bind to the surface of the base material membrane via a covalent bond; wherein

the weight percentage of the hydrophilic polymer(s) constituting the functional layer is 1.5% to 35% based on the total weight of the separation membrane.

[Claim ~~3~~2]

The membrane separation culture device according to claim 1 ~~or 2~~, wherein the size of the pore is 3 μm to 10 μm and the density of the pore is 1×10^5 to 4×10^6 pores/cm^2.

[Claim ~~4~~3]

The membrane separation culture device according to any one of claims 1 to ~~3~~2, comprising a plurality of the upper structures, and

further comprising a frame body that is accommodated in the lower structure and comprises a plate-like member having a plurality of holes each established to lock the plurality of the upper structures.

[Claim ~~5~~4]

The membrane separation culture device according to claim 1~~ or 2~~, comprising a plurality of the upper structures, and further comprising a frame body that is accommodated in the lower structure and comprises a plate-like member having a plurality of holes each established to lock the plurality of the upper structures, wherein the lower structure is constituted with a plurality of vessels each corresponding to the plurality of the upper structures.

[Claim ~~6~~5]

The membrane separation culture device according to claim ~~4~~3 or ~~5~~4, wherein the plurality of the upper structures have membranes each having a different pore size and/or a different pore density.

[Claim ~~7~~6]

The membrane separation culture device according to any one of claims 1 to ~~6~~5, which further comprises a lid structure for covering or hermetically sealing the upper structure and the lower structure.

[Claim ~~8~~7]

The membrane separation culture device according to claim ~~7~~6, wherein the lid structure further comprises a gas exchanger comprising a gas inlet port and a gas discharge port.

[Claim ~~9~~8]

The membrane separation culture device according to claim ~~7~~ 6 or ~~8~~ 7, wherein at least a portion of the lid structure is formed with a membrane having pores whose pore size is 1 to 100 nm.

[Claim ~~10~~ 9]

The membrane separation culture device according to any one of claims ~~7~~ 6 to ~~9~~ 8, wherein a hermetic sealing elastic body is established between the lid structure and the lower structure.

[Claim ~~11~~ 10]

The membrane separation culture device according to any one of claims ~~7~~ 6 to ~~10~~ 9, further comprising a temperature control system containing a temperature-measuring device and a temperature-controlling device.

[Claim ~~12~~ 11]

The membrane separation culture device according to any one of claims 1 to ~~11~~ 10, wherein the lower structure further comprises a medium replacement system comprising a medium inlet port and a medium outlet port.

[Claim ~~13~~ 12]

A membrane separation culture kit comprising a membrane separation culture device according to any one of claims 1 to ~~12~~ 11 and cell migration factor(s) to be poured into the lower structure.

[Claim ~~14~~ 13]

The kit according to claim ~~13~~ 12, wherein the cell migration factor(s) are one or more selected from SDF-1, G-CSF, bFGF, TGF-β, NGF, PDGF, BDNF, GDNF, EGF, VEGF, SCF, MMP3, Slit, GM-CSF, LIF, HGF, S1P, protocatechuic acid, and serum.

[Claim ~~15~~ 14]

The kit according to claim ~~13~~ 12 or ~~14~~13, wherein the concentration of the cell migration factor(s) is 1 ng/ml to 500 ng/ml.

[Claim ~~16~~15]

The kit according to claim ~~13~~12, which further comprises serum to be poured into the lower structure and wherein the cell migration factor is G-CSF or bFGF.

[Claim ~~17~~16]

A method for separating stem cells using the membrane separation culture device according to any one of claims 1 to ~~12~~11, wherein the method comprises:

a step of dispersing test cells or test tissues on the membrane of the upper structure;

a step of filling the vessel as a lower structure with a medium containing cell migration factor(s); and

a step of allowing the membrane of the upper structure to come into contact with the medium in the lower structure.

[Claim ~~18~~17]

The method according to claim ~~17~~16, wherein the cell migration factor(s) are one or more selected from SDF-1, G-CSF, bFGF, TGF-β, NGF, PDGF, BDNF, GDNF, EGF, VEGF, SCF, MMP3, Slit, GM-CSF, LIF, HGF, S1P, protocatechuic acid, and serum.

[Claim ~~19~~18]

The method according to claim ~~17~~16 or ~~18~~17, wherein the concentration of the cell migration factor(s) is 1 ng/ml to 500 ng/ml.

[Claim ~~20~~19]

The method according to any one of claims ~~17~~16 to ~~19~~18, wherein the test cells are dispersed at a density of 3×10^2 cells to 3×10^4 cells per mm^2 of the separation membrane.

[Claim ~~21~~20]

The method for separating stem cells according to claim ~~17~~16, wherein the stem cells are dental pulp stem cells, the cell migration factor is G-CSF or bFGF, the concentration of the G-CSF or bFGF is 50 to 150 ng/ml, the test cells are dispersed at a density of 3×10^2 to 1.5×10^3 cells per mm^2 of the separation membrane, or the test tissues are left at rest at a density of 0.1 mg to 1 mg per mm^2 of the separation membrane, and serum is added to a medium containing the cell migration factor at a volume percentage of 5% to 20% based on the volume of the medium.

[Claim ~~22~~21]

The method for separating stem cells according to claim ~~17~~16, wherein the stem cells are bone marrow stem cells or adipose stem cells, the cell migration factor is G-CSF or bFGF, the concentration of the G-CSF or bFGF is 50 to 150 ng/ml, the test cells are dispersed at a density of 3×10^2 to 1.5×10^3 cells per mm^2 of the separation membrane, or the test tissues are left at rest at a density of 0.1 mg to 1 mg per mm^2 of the separation membrane, and serum is added to a medium containing the cell migration factor at a volume percentage of 5% to 20% based on the volume of the medium.

~~[Claim 23]~~

~~A separation membrane comprising:~~

~~a base material membrane consisting of a hydrophobic polymer; and~~

~~a functional layer formed by allowing one or more hydrophilic polymers selected from a vinyl pyrrolidone polymer, a polyethylene glycol polymer and a vinyl alcohol polymer to bind to the surface of the base material membrane via a covalent bond; wherein~~

~~the weight percentage of the hydrophilic polymer(s) constituting the functional layer is 1.5% to 35% based on the total weight of the separation membrane.~~

~~[Claim 24]~~

The separation membrane according to claim 23, wherein the base material membrane has pores with a pore size of 1 to 10 μm and the base material membrane is used for cell separation.

[Claim 25]

The separation membrane according to claim 23 or 24, wherein the hydrophobic polymer is selected from the group consisting of a sulfone polymer, an amide polymer, a carbonate polymer, an ester polymer, a urethane polymer, an olefin polymer, and an imide polymer.

[Claim 26]

The separation membrane according to any one of claims 23 to 25, which is used for separating cells by permeation.

[Claim 27]

A method for producing the separation membrane according to any one of claims 23 to 26, which comprises:

an immersion step of immersing a base material membrane consisting of a hydrophobic polymer having a water absorption percentage of 2% or less in a treating aqueous solution containing one or more hydrophilic polymers selected from a vinyl pyrrolidone polymer, a polyethylene glycol polymer and a vinyl alcohol polymer at a concentration of 10 to 2000 ppm, and also containing a 0.01% to 0.2% alcohol; and

a modification step of irradiating the base material membrane with a high-energy beam to modify the surface of the membrane to have a protein adhesion-suppressing property and a cell adhesion-suppressing property.

[Claim 28]

A method for producing the separation membrane according to any one of claims 23 to 26, which comprises:

an immersion step of immersing a base material membrane consisting of a hydrophobic polymer having a water absorption percentage of more than 2% in an aqueous solution containing one or more hydrophilic polymers selected from a vinyl pyrrolidone polymer, a polyethylene glycol polymer and a vinyl alcohol polymer at a concentration of 10 to 2000 ppm; and

a modification step of irradiating the base material membrane with a high-energy beam to modify the surface of the membrane to have a protein adhesion-suppressing property and a cell adhesion-suppressing property.

[Claim 29]

The modification method according to claim 27 or 28, wherein the hydrophobic polymer is selected from the group consisting of a sulfone polymer, an amide polymer, a carbonate polymer, an ester polymer, a urethane polymer, an olefin polymer, and an imide polymer.

[Claim 30]

A method for modifying the surface of a molded body, which comprises:

an immersion step of immersing a molded body having a water absorption percentage of 2% or less in a treating aqueous solution containing one or more hydrophilic polymers selected from a vinyl pyrrolidone polymer, a polyethylene glycol polymer and a vinyl alcohol polymer at a concentration of 10 to 2000 ppm, and also containing a 0.01% to 0.2% alcohol; and

a modification step of irradiating the molded body with a high-energy beam to modify the surface of the molded body to have a protein adhesion-suppressing property and a cell adhesion-suppressing property.

[Claim 31]

A method for modifying the surface of a molded body, which comprises:

an immersion step of immersing a molded body having a water absorption percentage of more than 2% in an aqueous solution containing one or more hydrophilic polymers selected from a vinyl pyrrolidone polymer, a polyethylene glycol polymer and a vinyl alcohol polymer at a concentration of 10 to 2000 ppm; and

a modification step of irradiating the molded body with a high-energy beam to modify the surface of the molded body to have a protein adhesion-suppressing property and a cell adhesion-suppressing property.

[Claim 32]

A method for producing the separation membrane according to any one of claims 23 to 26, using the modification method according to claim 30 or 32.