Patent Literature 4: JP 2001-190267 A

Patent Literature 5: JP 2016-077164 A

Non Patent Literatures

[0010]

Non Patent Literature 1: Stevens, K. M., Oxygen requirements for liver cells in vitro., Nature, 206, 199 (1965)

Non Patent Literature 2: Xiao W, Shinohara M, Komori K, Sakai Y, Matsui H, Osada T, A (2014): The importance of physiological oxygen concentrations in the sandwichi cultures of rat hepatocytes on gas-permeable membranes, Biotechnol. Prog., 30(6), 1401-1410

Non Patent Literature 3: Yasuyuki Sakai, "Enhanced oxygen supply in hepatocyte culture" [online] The Japanese Society for the Research of Hepatic Cells [searched on April 9 2019] Internet <http://hepato.umin.jp/kouryu/kouryu28.html>

Summary

[0010a]

In a first aspect, the present disclosure refers to a culture material comprising a 4-methyl-1-pentene polymer (X) for cells, tissues, or organs, the culture material having a water contact angle at a culture surface of 50° to 100°,

a sagging distance by a test method (A) described

below of 0 to 5 mm, and

an oxygen permeation rate at a temperature of 23°C and a humidity of 0% of 4500 to 90000 $cm^3/(m^2 \times 24h \times atm)$,

wherein the content of a structural unit derived from 4-methyl-1-pentene is 80 to 100 mol%, and the content of a structural unit derived from at least one type of olefin selected from ethylene and an α-olefin having 3 to 20 carbon atoms (excluding 4-methyl-1-pentene) is 0 to 20 mol%, with all repeating structural units being 100 mol%,

wherein the thickness of the culture material is 20 to 500 μm,

wherein the culture material is subjected to a hydrophilic treatment on its surface, and

wherein

in the test method (A), a test piece having the same material as the culture material and the same thickness as the culture surface of the culture material and having a flat plate shape of 100 mm long and 10 mm wide is made,

the test piece is fixed onto a test board in a state where the test piece protrudes lengthwise a length of 50 mm in a horizontal direction from a top surface of the test board, the top surface being horizontal, and

three minutes after fixing, a measurement is performed of a distance of how much an end of the test piece protruding

from the test board sags in a vertically downward direction from a horizontal plane including the top surface of the test board, provided that the fixing to the measurement is performed at room temperature.

[0010b]

In another aspect, the present disclosure refers to a microchannel device comprising the culture material disclosed herein.

[0010c]

In yet another aspect, the present disclosure refers to a culture vessel, wherein at least a culture surface is formed of the culture material disclosed herein.

[0010d]

In a further aspect, the present disclosure refers to a culture tool comprising the culture material disclosed herein or the culture vessel disclosed herein.

[0010e]

In another aspect, the present disclosure refers to a method for culturing cells, tissues, or organs, comprising a step of incubating cells, tissues, or organs in the culture tool disclosed herein.

Technical Problem

[0011]

The inventors of the present invention have considered that it is important to create a culture material that is superior in oxygen supply capacity with little deformation such as warping in order to culture cells, tissues, or organs (hereinafter, referred to as “cells, etc.”) in vitro in a

CLAIMS

1. A culture material comprising a 4-methyl-1-pentene polymer (X) for cells, tissues, or organs, the culture material having a water contact angle at a culture surface of 50° to 100°,

a sagging distance by a test method (A) described below of 0 to 5 mm, and

an oxygen permeation rate at a temperature of 23°C and a humidity of 0% of 4500 to 90000 $cm^3/(m^2 \times 24h \times atm)$,

wherein the content of a structural unit derived from 4-methyl-1-pentene is 80 to 100 mol%, and the content of a structural unit derived from at least one type of olefin selected from ethylene and an α-olefin having 3 to 20 carbon atoms (excluding 4-methyl-1-pentene) is 0 to 20 mol%, with all repeating structural units being 100 mol%,

wherein the thickness of the culture material is 20 to 500 μm,

wherein the culture material is subjected to a hydrophilic treatment on its surface, and

wherein

in the test method (A), a test piece having the same material as the culture material and the same thickness as the culture surface of the culture material and having a flat plate shape of 100 mm long and 10 mm wide is made,

the test piece is fixed onto a test board in a state where the test piece protrudes lengthwise a length of 50 mm in a horizontal direction from a top surface of the test board, the top surface being horizontal, and

three minutes after fixing, a measurement is performed of a distance of how much an end of the test piece protruding from the test board sags in a vertically downward direction from a horizontal plane including the top surface of the test board, provided that the fixing to the measurement is performed at room temperature.

2. The culture material according to claim 1, wherein the 4-methyl-1-pentene polymer (X) is at least one type of polymer selected from a 4-methyl-1-pentene homopolymer (x1) and a copolymer (x2) of 4-methyl-1-pentene and at least one type of olefin selected from ethylene and an α-olefin having 3 to 20 carbon atoms (excluding 4-methyl-1-pentene).

3. The culture material according to claim 1 or 2, wherein when a test method (B) described below is performed with rat primary-cultured liver cells to be seeded having a cell density of $1.0 \times 10^5$ cells/$cm^2$ to $4.0 \times 10^5$ cells/$cm^2$, a dissolved oxygen concentration in a culture solution after 1 hour is 2 to 20% of a saturated oxygen concentration in the culture solution for at least one point in the range of the cell density,

in the test method (B), a culture vessel comprising a cylindrical portion composed of polyethylene and a bottom surface portion having a flat plate shape and having the same material as the culture material and the same thickness as the culture surface of the culture material, the culture vessel having a culture area of 2 $cm^2$ and being coated with collagen, is made, the culture vessel is seeded with rat primary-cultured liver cells with 0.5 ml of a culture solution for rat primary-cultured liver cells and cultured at a temperature of 37°C, a carbon dioxide concentration of 5.0%, and an oxygen concentration of 20%, twenty four hours after seeding, the culture solution is removed from the culture vessel, and 0.5 ml of the culture solution is newly added to the culture vessel, and an oxygen concentration is measured at 80 μm height from a bottom surface of the culture vessel for 1 hour.

4. The culture material according to claim 3, wherein when the test method (B) is performed with rat primary-cultured liver cells to be seeded having a cell density of $1.0 \times 10^5$ cells/$cm^2$ to $4.0 \times 10^5$ cells/$cm^2$, an oxygen consumption rate is 40 to 150 pmol/s/$10^5$ cells for at least one point in the range of the cell density.

5. The culture material according to any one of claims 1 to 4, which is a film, a sheet, or a culture vessel.

6. The culture material according to claim 5, wherein the culture vessel is a petri dish, a flask, an insert, a plate, a bottle, or a bag.

7. The culture material according to any one of claims 1 to 6, wherein the culture surface is microfabricated.

8. A microchannel device comprising the culture material according to claim 7.

9. A culture vessel, wherein at least a culture surface is formed of the culture material according to any one of claims 1 to 7.

10. The culture vessel according to claim 9, comprising at least one well.

11. A culture tool comprising the culture material according to any one of claims 1 to 7 or the culture vessel according to claim 9 or 10.

12. The culture tool according to claim 11, wherein the culture surface is coated with a natural polymer material, a synthetic polymer material, or an inorganic material.

13. A method for culturing cells, tissues, or organs, comprising a step of incubating cells, tissues, or organs in the culture tool according to claim 11 or 12.

14. The method for culturing cells, tissues, or organs according to claim 13, wherein the cells, tissues, or organs are liver cells.