What is claimed is:

1. A planar patch clamp device for analyzing a neuron network, comprising:

an electrical insulating plate having a first surface, on which a neuron network is formed, a second surface, which is the opposite side, and a through-hole having a diameter which allows passing through both sides of the plate surface, but does not allow the passage of a cell body;

a first liquid pool section formed on the first surface, which enables holding cell culture meduium;

a second liquid pool section formed on the second surface, which enables holding cell culture medium, and is communicated with the first liquid pool through the through-hole;

an first surface side-electrode disposed to be electrically conductive to the cell culture medium;

an second surface side-electrode disposed to be electrically conductive to the conducting liquid;

wherein cell plating section surrounded by a plurality of protrusions is formed on the first surface so that the protrusions restrict the movement of cells, but allow the formation of a neuron network, the through-hole is arranged in the cell plating section, and the peripheries of the through-hole is coated with an extracellular matrix-forming substance.

2. The planar patch clamp device for analyzing a neuron network according to claim 1, wherein the diameter of the cell plating section defined by the plurality of protrusions is a size enables to accommodate one to several cell bodies.

3. The planar patch clamp device for analyzing a neuron network according to claim 1 or 2, wherein the plurality of cell plating sections defined by the plurality of protrusions are arranged on the plate.

4. The planar patch clamp device for analyzing a neuron network according to any one of claims 1 - 3, one to several cell bodies are placed in the cell placing section, and another cell body is placed outside of the cell placing section.

5. The planar patch clamp device for analyzing a neuron network according to any one of claims 1 - 4, characterized in that the electrode sections on the first surface side and second surface side comprises:

an electrode receptacle, wherein at least a portion of the receptacle wall that is in contact with the conducting liquid, when the conducting liquid is introduced into the liquid pool sections, is composed of an inorganic porous material.

an electrode having a precious metal chloride (NmCl) layer formed on a surface layer section of the precious metal (Nm), and housed in the electrode receptacle.

an electrode solution filled into the electrode receptacle, wherein the precious metal chloride (NmCl) and an alkali metal chloride are dissolved at saturated concentration.

6. The planar patch clamp device for analyzing a neuron network according to any one of claims 1 - 5, characterized in that the device is used for measurement and analysis of neuronal ion channel current or for imaging analysis.

7. The planar patch clamp device for analyzing a neuron network according to any one of claims 1 - 6 further comprising:

a photodetector for detecting light emitted by neurons;

an irradiating device that irradiates light onto the neurons or plate surface.

8. A cell seeding device for seeding cell bodies in multiple cell plating sections surrounded by a plurality of protrusions on a plate of a planar patch clamp device, comprising:
(1) a suspension supply port for externally supplying cell suspension;
(2) a plurality of fine suspension flow channels extending in a branched manner from the suspension supply port, inside the device body, and
(3) a suspension injection port for injecting the cell suspension into each cell plating section, opened at the bottom of the device body at the end of each suspension flow channel
wherein the neuron seeding device is a board-shaped device body that can be set on the apparatus plate has a size covering the multiple cell plating sections and the flat bottom of the device body is in contact with the apexes of the plurality of protrusions at the multiple cell plating sections in the set situation.

9. The neuron seeding device according to claim 8, characterized in that the plurality of suspension flow channels are set to have substantially the same lengths, and the design is such that when the neuron seeding device is placed on the apparatus plate of the culturing device for formation of a neuron network or the planar patch-clamp device, the individual suspension injection ports are located to precisely correspond with the individual cell plating sections.

10. The neuron seeding device according to claim 8 or claim 9, characterized in that the board-shaped device body comprises an upper board provided with the suspension supply ports and a lower board provided with the suspension injection ports, joined in a closely bonded state, and grooves composing the suspension flow

channels are formed on at least one of the bonding surfaces of the upper board and lower board.

11. The neuron seeding device according to any one of claims 8 to 10, wherein the device body further comprises a second suspension flow channel system for injection of the neuron suspension into regions other than the cell plating sections of the apparatus plate of the culturing device for formation of a neuron network or the planar patch-clamp device.

What is claimed is:

[Claim 1]

1. A culture type planar patch clamp device for a neuron network, comprising:

an electrical insulating plate having a through-hole;

a first liquid pool section formed on the first surface of said electrical insulating plate;

a second liquid pool section formed on the second surface which is opposite side of the first surface; and

electrodes disposed to be electrically conductive to a conductive liquid which is introduced into the first liquid pool section and the second liquid pool section;

wherein a cell plating section which is surrounded by a plurality of protrusions around the through hole is formed on the first surface;

wherein the plurality of protrusions has a space which does not allow a cell body of neuron to pass through; and

wherein the electrodes are characterized in having following (a) - (c):

(a) an electrode receptacle, wherein at least a portion of the receptacle wall that is in contact with the conducting liquid, when the conducting liquid is introduced into the liquid pool sections, is composed of an inorganic porous material.

(b) an electrode having a precious metal chloride (NmCl) layer formed on a surface layer section of the precious metal (Nm), and housed in the electrode receptacle.

(c) an electrode solution filled into the electrode receptacle, wherein the precious metal chloride (NmCl) and an alkali metal chloride are dissolved at saturated concentration.

[Claim 2]

The culture type planar patch clamp device for a neuron network according to claim 1, wherein the diameter of the cell plating section defined by the plurality of protrusions is a size enables to accommodate one to several cell bodies.

[Claim 3]

The culture type planar patch clamp device for a neuron network according to claim 1 or 2, wherein an extracellular matrix-forming substance is coated on the surface of the plate constituting the cell plating section.

[Claim 4]

The culture type planar patch clamp device for a neuron network according to

any one of claims 1 - 3, wherein the plurality of cell plating sections defined by the plurality of protrusions are arranged on the plate and the cell plating sections are arranged at an intervals which allows the formation of a neuron network.

[Claim 5]

The culture type planar patch clamp device for a neuron network according to any one of claims 1 - 4, whereing the culture type planar patch clamp device for a neuron network is characterized in being used for a purpose according to any one of the following (A) to (C):

(A) for measurement and analysis of neuronal ion channel current in a neuron network;

(B) for imaging analysis, including at least Ca imaging analysis, imaging analysis with synaptophysin or synapsin labeling as synaptic site markers, imaging analysis with MAP2 as a dendrite marker, and imaging analysis with FM1-43 or FM4-64 which labels endosomes or exosomes;

(C) for high throughput system of neuron.

[Claim 6]

The culture type planar patch clamp device for a neuron network according to claim 5 characterized in that when the culturing device for formation of a neuron network is used for imaging analysis according to (B), the culturing device comprises one or more of the following constituents (D) to (F).

(D) a photodetector for detecting light emitted by neurons is set above the plate;

(E) an irradiating device that irradiates light onto the neurons or plate surface is set above the plate;

(F) the irradiating device of (E) is equipped with an optical focusing system for irradiation of light only on a prescribed single neuron.

[Claim 7]

A method of forming a neuron network under culturing for any research purpose by means of the culture type planar patch clamp device for a neuron network according to any one of claims 1 to 6, the method comprising:

(1) seeding neurons on said plate that is filled with cell culture medium,

(2) placing and/or plating one or several neurons in each cell plating section by an extracellular matrix-forming substance in the cell plating section, and/or by

suctioning liquid medium from the fine through-holes at the bottom of the cell plating section, and

(3) forming synaptic junctions between neurons by axons or dendrites, wherein while movement of the neurons plated in the cell plating section is restricted by the plurality of protrusions, the presence of adjacent neurons is mutually recognized through the gap sections of the plurality of protrusions.

[Claim 8]

The method of forming a neuron network according to claim 7, characterized in that during seeding of the neurons in step (1), glial cells are also seeded at sections other than the cell plating sections.