WHAT IS CLAIMED IS:

1. A method of electrochemically producing a hydrogel by using electrolytic deposition of a hydrogel, the method by which a hydrogel is formed by a reaction which is induced in an electrolytic solution by an electrode product electrochemically generated by electrodes installed in the electrolytic solution, the method comprising

a preparing step of providing an apparatus including an electrolytic tank and housing an electrolytic solution therein, the electrolytic tank having a two-dimensional array of working electrodes provided on a bottom surface thereof and a counter electrode installed therein, the electrolytic solution containing a dissolved substance which causes electrolytic deposition of the hydrogel;

a first step of forming a hydrogel with a two-dimensionally defined first pattern on the bottom surface, by applying a first voltage as a predetermined voltage to a first working electrode group as one or more selected working electrodes of the two-dimensional array of working electrodes, the first pattern corresponding to an arrangement of the selected working electrodes; and

a second step of forming a hydrogel with a two-dimensionally defined second pattern on the bottom surface, by applying a second voltage as a predetermined voltage to a second working electrode group as one or more selected working electrodes of the two-dimensional array of working electrodes, the second pattern corresponding to an arrangement of the selected working electrodes, wherein

the second step is performed after the first step, and

a hydrogel with a three-dimensionally defined pattern including at least two layers is formed such that one of the two layers having the second pattern is located under an other of the two layers having the first pattern on a side thereof closer to the bottom surface.

2. The method of electrochemically producing a hydrogel according to Claim 1, wherein

at least one of the first step and the second step includes a first sub-step and a second sub-step, a corresponding one of the first working electrode group and the second working electrode group includes a first working electrode sub-group and a second working electrode sub-group, a corresponding one of the first voltage and the second voltage includes a first sub-voltage and a second sub-voltage, and a corresponding one of the first pattern and the second pattern incudes a first sub-pattern and a second sub-pattern,

the second working electrode sub-group consists of only working electrodes which do not belong to the first working electrode sub-group, and

a hydrogel with the first sub-pattern is formed by applying the first sub-voltage to the first working electrode sub-group and a hydrogel with the second sub-pattern is formed by applying the second sub-voltage to the second working electrode sub-group.

3. The method of electrochemically producing a hydrogel according to Claim 2, wherein

in the second sub-step, a hydrogel which dissolves under a predetermined condition is formed, and

the method further includes, after at least both of the first sub-step and the second sub-step, a sub-pattern removal step of selectively removing the hydrogel with the second sub-pattern by dissolving the hydrogel with the second sub-pattern by providing the hydrogel with the second sub-pattern with the predetermined condition.

4. The method of electrochemically producing a hydrogel according to any one of Claims 1 to 3, wherein

a Z stage that has an adhesion surface facing parallel the bottom surface and is displaceable in a Z direction perpendicular to the bottom surface is further provided,

by performing the first step with the Z stage being located in the electrolytic solution such that the adhesion surface is apart from the bottom surface by a first distance, the hydrogel with the first pattern is formed such that an upper surface thereof adheres to the adhesion surface, wherein the upper surface is one, on a side farther apart from the bottom surface, of two surfaces perpendicular to the Z direction,

and after that, by displacing the Z stage, to the adhesion surface of which the upper surface of the first pattern adheres, in a direction in which the Z stage moves away from the bottom surface, a lower surface of the first pattern is moved away from the bottom surface by a second distance, wherein the lower surface is an other, on a side closer to the bottom surface, of the two surfaces perpendicular to the Z direction, and

by performing the second step with the first pattern being located in the electrolytic solution such that the lower surface is apart from the bottom surface by the second distance, the hydrogel with the second pattern connecting to the lower surface of the first pattern is formed.

5. The method of electrochemically producing a hydrogel according to Claim 4, wherein

the adhesion surface is subjected to treatment that makes the adhesion surface have an affinity for water.

6. The method of electrochemically producing a hydrogel according to any one of Claims 1 to 5, wherein

all of the first working electrode groups are included in the second working electrode group, and

the three-dimensionally defined pattern has a structure in which the first pattern is supported from below by the second pattern.

7. The method of electrochemically producing a hydrogel according to Claim 4 or 5, wherein

all of the second working electrode groups are included in the first working electrode group, and

the three-dimensionally defined pattern has a structure in which the second pattern is supported from above, which is a side where the adhesion surface is located, by the first pattern so as to hang therefrom.

8. The method of electrochemically producing a hydrogel according to any one of Claims 1 to 7, wherein

all of the working electrodes which compose the two-dimensional array protrude from the bottom surface and side faces of each protruding working electrode are surrounded with an insulating layer formed so as to protrude from the bottom surface along with the working electrode.

9. The method of electrochemically producing a hydrogel according to any one of Claims 1 to 8, wherein

a part of the bottom surface other than front surfaces of the working electrodes is made water-repellent.

10. The method of electrochemically producing a hydrogel according to any one of Claims 1 to 9, further comprising

a step of forming, on the bottom surface, a hydrogel with the two-dimensionally defined pattern corresponding to an arrangement of the selected working electrodes by applying the predetermined voltage to the selected working
electrodes, and after that, in a state in which the formed hydrogel is in contact with the selected working electrodes, promoting separation of the hydrogel from the selected working electrodes by dissolving a contact part of the hydrogel with the selected working electrodes by applying a voltage for hydrogel separation, which is different from the predetermined voltage, to the

selected working electrodes.

11. A method of producing a hydrogel patterned with cells, which is obtained by distributing prescribed cells over a hydrogel scaffold, wherein

by performing the method of electrochemically producing a hydrogel according to any one of Claims 1 to 10 by using a suspension as the electrolytic solution containing the dissolved substance which causes electrolytic deposition of the hydrogel, the suspension further containing the prescribed cells, the hydrogel having distributed therein the prescribed cells is formed on the bottom surface of the electrolytic tank.

12. A method of producing a hydrogel patterned with cells, which is obtained by distributing prescribed cells over a hydrogel scaffold, wherein

the prescribed cells include one or more types of cells, and

the method includes a step of performing the method of electrochemically producing a hydrogel according to Claim 1, wherein one of the first step and the second step is performed by using a suspension as the electrolytic solution concerned, the suspension containing one type of cells of the prescribed cells along with the dissolved substance which causes electrolytic deposition of the hydrogel concerned.

13. The method of producing a hydrogel patterned with cells according to Claim 12, wherein

an other of the first step and the second step is performed by using a suspension as the electrolytic solution concerned, the suspension containing an other type of cells, the other type of cells being different from the one type of cells of the prescribed cells along with the dissolved substance which causes electrolytic deposition of the hydrogel concerned.

14. A method of producing a hydrogel patterned with cells, which is obtained by distributing prescribed cells over a hydrogel scaffold, wherein

the prescribed cells include one or more types of cells, and

the method of electrochemically producing a hydrogel according to Claim 2 is performed, wherein one of the first sub-step and the second sub-step is performed by using a suspension as the electrolytic solution concerned, the suspension containing one type of cells of the prescribed cells along with the dissolved substance which causes electrolytic deposition of the hydrogel concerned.

15. The method of producing a hydrogel patterned with cells according to Claim 14,

wherein

an other of the first sub-step and the second sub-step is performed by using a suspension as the electrolytic solution concerned, the suspension containing an other type of cells, the other type of cells being different from the one type of cells of the prescribed cells along with the dissolved substance which causes electrolytic deposition of the hydrogel concerned.

16. The method of producing a hydrogel patterned with cells according to any one of Claims 11 to 15, comprising

before a step of forming a hydrogel by applying the predetermined voltage to the selected working electrodes in a state in which the suspension is housed in the electrolytic tank, a dielectrophoresis step of densely distributing the prescribed cells on the selected working electrodes by dielectrophoresis by applying an alternating voltage of a predetermined frequency to the selected working electrodes.

17. The method of producing a hydrogel patterned with cells according to Claim 16, wherein

in the dielectrophoresis step, an electrode with an electrode plane facing, parallel to the bottom surface, a region of the bottom surface in which the two-dimensional array of the working electrodes is provided is used.

18. The method of producing a hydrogel patterned with cells according to Claim 16, wherein

in the dielectrophoresis step, an electrode which is provided on the bottom surface so as to be located around each of the two-dimensional array of the working electrodes is used.

19. The method of producing a hydrogel patterned with cells according to any one of Claims 11 to 15, comprising

before a step of forming a hydrogel by applying the predetermined voltage to the selected working electrodes in a state in which the suspension is housed in the electrolytic tank, an electrophoresis step of densely distributing the prescribed cells on the selected working electrodes by electrophoresis by applying a predetermined direct voltage to the selected working electrodes.