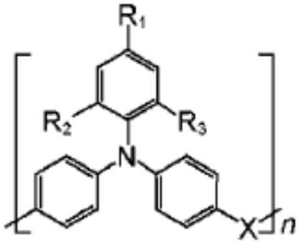
CLAIMS

1. A method for producing oxygen and hydrogen from water, comprising:

immersing, in water, an aromatic amine polymer as a catalyst for generating oxygen by oxidation of water (which catalyst will hereinafter be called “water-oxidation·oxygen-generation catalyst”) and a polyarylenevinylene or derivative thereof as a catalyst for generating hydrogen by reduction of water (which catalyst will hereinafter be called “water reduction·hydrogen-generation catalyst”); connecting the water-oxidation·oxygen-generation catalyst and the water-reduction·hydrogen-generation catalyst to each other with a conductive wire; and applying a voltage and/or irradiating the water-oxidation·oxygen-generation catalyst with light.

2. The method for producing oxygen and hydrogen according to Claim 1, wherein the aromatic amine polymer is represented by the following formula (I):

[Chemical formula 1]



(I)

(wherein,

n represents an integer,

R1 represents -H, an alkyl group, a phenyl group, a halogen group, an ether group, a carbazole group, a triphenylamine group, a nitro group, an acetylenyl group, a thienyl group, an amino group, a formyl group, or a boron group,

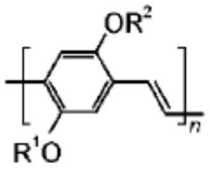
R2 and R3 are the same or different and each represent -H or an alkyl group, and

X does not exist or represents a fluorene group).

3. The method for producing oxygen and hydrogen according to Claim 1~~ or 2~~,

wherein the polyarylenevinylene is a poly(phenylenevinylene) represented by the following formula (II):

[Chemical formula 2]



(II)

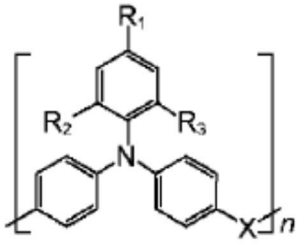
(wherein, n represents an integer,

R1 and R2 are the same or different and each represent an alkyl group).

4. A method for producing oxygen, comprising: immersing, in water, an aromatic amine polymer as a catalyst for generating oxygen by oxidation of water (which catalyst will hereinafter be called “water-oxidation·oxygen-generation catalyst”); and applying a voltage and/or irradiating with light.

5. A water-oxidation·oxygen-generation catalyst for use in the method for producing oxygen and hydrogen as claimed in Claim~~s~~ 1 ~~to 3~~ and the method for producing oxygen as claimed in Claim 4, wherein the aromatic amine polymer is a poly(triphenylamine) represented by the following formula (III):

[Chemical formula 3]



(III)

(wherein, n represents an integer,

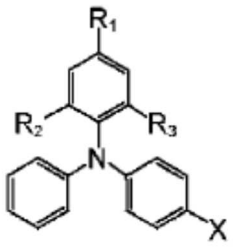
R1 represents -H, an alkyl group, a phenyl group, a halogen group, an ether group, a carbazole group, a triphenylamine group, a nitro group, an acetylenyl group, a thienyl group, an amino group, a formyl group, or a boron group,

R2 and R3 are the same or different and each represent -H or an alkyl group, and

X does not exist or represents a fluorene group).

6. A method for producing the water-oxidation·oxygen-generation catalyst as claimed in Claim 5, comprising: applying a triphenylamine represented by the following formula (IV) onto a conductive thin plate or a conductive nonwoven fabric and exposing the resulting thin plate or nonwoven fabric to iodine vapor or adding iodine to a solution of the triphenylamine to cause an oxidative polymerization reaction and thereby obtain the poly(triphenylamine):

[Chemical formula 4]



(IV)

(wherein,

R1 represents -H, an alkyl group, a phenyl group, a halogen group, an ether group, a carbazole group, a triphenylamine group, a nitro group, an acetylenyl group, a thienyl group, an amino group, a formyl group, or a boron group,

R2 and R3 are the same or different and each represent -H or an alkyl group, and

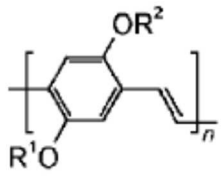
X represents -H or a fluorene group).

7. The production method according to Claim 6, wherein a thin layer of the aromatic amine polymer is formed on the conductive thin plate or the conductive nonwoven fabric or a thin plate composed of the aromatic amine polymer and a conductive assistant is formed.

8. A method for producing hydrogen, comprising: immersing, in water, a polyarylenevinylene or a derivative thereof as a catalyst for generating hydrogen by reduction of water (which catalyst will hereinafter be called “water-reduction·hydrogen-generation catalyst”); and applying a voltage.

9. A water-reduction·hydrogen-generation catalyst for use in the method for producing oxygen and hydrogen as claimed in Claim~~s~~ 1 ~~to 3~~ and the method for producing hydrogen as claimed in Claim 8, wherein the polyarylenevinylene is a poly(phenylenevinylene) represented by the following formula (V):

[Chemical formula 5]



(V)

(wherein,

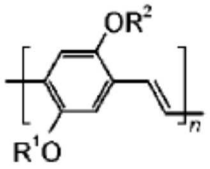
n represents an integer, and

R1 and R2 are the same or different and each represent an alkyl group).

10. A method for producing the water-reduction·hydrogen-generation catalyst as claimed in Claim 9, comprising: forming a thin layer of the polyarylenevinylene or derivative thereof on a conductive thin plate or a conductive nonwoven fabric or forming a thin plate composed of the polyarylenevinylene or derivative thereof and a conductive assistant.

11. The method for producing oxygen and hydrogen according to Claim 2, wherein the polyarylenevinylene is a poly(phenylenevinylene) represented by the following formula (II):

[Chemical formula 2]



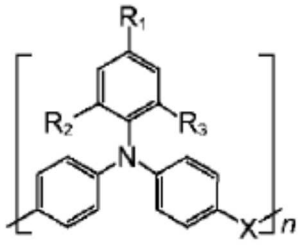
(II)

(wherein, n represents an integer,

R1 and R2 are the same or different and each represent an alkyl group).

12. A water-oxidation·oxygen-generation catalyst for use in the method for producing oxygen as claimed in Claim 4, wherein the aromatic amine polymer is a poly(triphenylamine) represented by the following formula (III):

[Chemical formula 3]



(III)

(wherein, n represents an integer,

R1 represents -H, an alkyl group, a phenyl group, a halogen group, an ether group, a carbazole group, a triphenylamine group, a nitro group, an acetylenyl group, a thienyl group, an amino group, a formyl group, or a boron group,

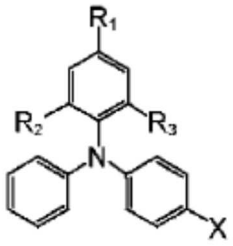
R2 and R3 are the same or different and each represent -H or an alkyl group, and

X does not exist or represents a fluorene group).

13. A method for producing the water-oxidation·oxygen-generation catalyst as claimed in Claim 12, comprising: applying a triphenylamine represented by the following formula (IV) onto a conductive thin plate or a conductive nonwoven fabric and exposing the resulting thin plate or nonwoven fabric to iodine vapor or adding iodine to a solution of the triphenylamine to cause an oxidative polymerization

reaction and thereby obtain the poly(triphenylamine):

[Chemical formula 4]



(IV)

(wherein,

R1 represents -H, an alkyl group, a phenyl group, a halogen group, an ether group, a carbazole group, a triphenylamine group, a nitro group, an acetylenyl group, a thienyl group, an amino group, a formyl group, or a boron group,

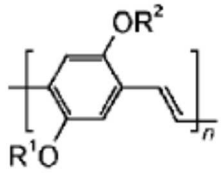
R2 and R3 are the same or different and each represent -H or an alkyl group, and

X represents -H or a fluorene group).

14. The production method according to Claim 13, wherein a thin layer of the aromatic amine polymer is formed on the conductive thin plate or the conductive nonwoven fabric or a thin plate composed of the aromatic amine polymer and a conductive assistant is formed.

15. A water-reduction·hydrogen-generation catalyst for use in the method for producing hydrogen as claimed in Claim 8, wherein the polyarylenevinylene is a poly(phenylenevinylene) represented by the following formula (V):

[Chemical formula 5]



(V)

(wherein,

n represents an integer, and

R1 and R2 are the same or different and each represent an alkyl group).

16. A method for producing the water-reduction·hydrogen-generation catalyst as claimed in Claim 15, comprising: forming a thin layer of the polyarylenevinylene or derivative thereof on a conductive thin plate or a conductive nonwoven fabric or forming a thin plate composed of the polyarylenevinylene or derivative thereof and a conductive assistant.