CLAIMS

1. A system for splitting water in a solution, the system comprising:
a first vessel in communication with at least one electrolyser stack comprising:
at least one electrode comprising:
a compound comprising at least one catalytic material; and
a micro-porous structure;
at least one separator; and
a second vessel in communication with said at least one electrolyser stack, wherein the system is configured to split a water molecule in the solution to produce a hydrogen gas, and a nitrogen gas and/or an oxygen gas.

2. The system of claim 1 wherein said at least one catalytic material comprises a PGM.

3. The system of claim 1 wherein said at least one catalytic material comprises a non-PGM.

4. The system of any one of claims 1 to 3 wherein the micro-porous structure is formed from a leached sacrifying material co-deposited with the catalytic material.

5. The system of claim 4 wherein said sacrifying material comprises aluminum.

6. The system of any one of claims 1 to 5 wherein said at least one electrode further comprises a nano-porous structure.

7. The system of any one of claims 1 to 6 wherein said at least one electrode further comprises at least one doping agent.

8. The system of any one of claims 1 to 7 wherein a cell voltage of the system is < 100 mV.

9. The system of any one of claims 1 to 7 wherein a cell voltage of the system is 0 mV.

10. The system of any one of claims 1 to 8 wherein the system further comprises a photoelectrochemical system.

11. A method for splitting water in a solution, the method comprising:

passing a solution comprising at least one nitrogen compound into at least one electrolyser stack;

contacting the solution with at least one electrode comprising:

at least one catalytic material; and

a micro-porous structure;

splitting a water molecule in the solution to produce a hydrogen gas, and a nitrogen gas and/or an oxygen gas;

separating the oxygen gas and/or the nitrogen gas, and the hydrogen gas;

passing the hydrogen gas out of the at least one electrolyser stack; and

collecting the hydrogen gas.

12. The method of claim 11 further comprising applying an electric current to the electrode.

13. A method for manufacturing an electrode, the method comprising:

providing a substrate;

cleaning the substrate;

contacting the substrate with an acidic solution;

applying an electric current to the substrate;

drying or rinsing the substrate;

simultaneously depositing at least one main material and at least one supporting material comprising a sacrifying material onto the substrate;

thermally treating the substrate at a temperature of at least 300-1000°C; and

leaching the at least one sacrifying material deposited onto the substrate.

14. The method of claim 13 wherein the main material comprises a PGM.

15. The method of claim 13 wherein the main material comprises a non-PGM.

16. The method of any one of claims 13 to 15 wherein the at least one supporting material comprises a doping agent.

17. The method of any one of claims 13 to 16 wherein depositing the least one material comprises physical deposition.

18. The method of any one of claims 13 to 16 wherein depositing the least one material comprises chemical deposition.

19. An electrode for splitting water in a solution, the electrode comprising:

a substrate;

a porous structure contacting said substrate;

said porous structure comprising:

a main material;

a supporting material; and

a pore comprising a diameter sufficient to receive an atom of said supporting material; and

a doping agent,

wherein the electrode is configured to split a water molecule in the solution to produce a hydrogen gas, and a nitrogen gas and/or an oxygen gas.

20. The electrode of claim 19 wherein said porous structure comprises a micropore.

21. The electrode of claim 19 or 20 wherein said porous structure comprises a nanopore.

22. The electrode of any one of claims 19 to 21 wherein said main material and said supporting material are at least 25% the weight of said substrate.