CLAIMS

What is claimed is:

1. An electrolytic cell comprising:

a containment vessel;

a first electrode;

a second electrode;

a source of electrical current in electrical communication with the first electrode and the second electrode;

an electrolyte in fluid communication with the first electrode and the second electrode;

a gas, wherein the gas is formed during electrolysis at or near the first electrode; and

a separator;

wherein the separator comprises the first electrode and the first electrode comprises a first conductive material proximal to the source of electrical current and a dielectric material distal to the source of electrical current to control the location of nucleation of the gas by substantially separating the location of electron transfer and nucleation.

2. The electrolytic cell of claim 1 wherein first electrode further comprises a second conductive material proximal to the dielectric material and distal to the source of electrical current.

3. The electrolytic cell of claim 2 wherein the dielectric material comprises filaments.

4. The electrolytic cell of claim 3 wherein the dielectric material comprises a doped semiconductor.

5. The electrolytic cell of claim 3 wherein the dielectric material comprises carbon, silicon, carbon or boron nitride, or carbide.

6. The electrolytic cell of claim 2 wherein the separator further comprises a microorganism, and wherein the separator substantially retains the microorganism in a desired location.

7. An electrolytic cell comprising:

a containment vessel;

a first electrode;

a second electrode;

a source of electrical current in electrical communication with the first electrode and the second electrode;

an electrolyte in fluid communication with the first electrode and the second electrode;

a gas, wherein the gas is formed during electrolysis at or near the first electrode; and

a separator;

wherein the first electrode is configured to control the location of nucleation of the gas by substantially separating the location of electron transfer and nucleation.

8. The electrolytic cell of claim 7 wherein the first electrode comprises a topographical treatment to provide increased surface area.

9. The electrolytic cell of claim 8 wherein the topographical treatment comprises sandblasting, knurling, or electroplating with a catalytic nucleation agent.

10. The electrolytic cell of claim 8 wherein the topographical treatment comprises a topographical enhancement.

11. The electrolytic cell of claim 10 wherein the topographical enhancement comprises filaments.

12. The electrolytic cell of claim 10 wherein the topographical enhancement comprises a metal.

13. The electrolytic cell of claim 10 wherein the topographical enhancement comprises a doped semiconductor.

14. The electrolytic cell of claim 10 wherein the topographical enhancement comprises carbon, silicon, carbon or boron nitride, or carbide.

15. The electrolytic cell of claim 7 wherein the separator comprises the first electrode and the first electrode comprises a first conductive material proximal to the source of electrical current and a dielectric material distal to the source of electrical current.

16. The electrolytic cell of claim 15 wherein the first electrode further comprises a second conductive material proximal to the dielectric material and distal to the source of electrical current.

17. The electrolytic cell of claim 7 wherein the separator comprises the first electrode.

18. The electrolytic cell of claim 17 wherein the separator further comprises a microorganism, and wherein the separator substantially retains the microorganism in a desired location.

19. An electrolytic cell comprising:

a containment vessel;

a first electrode;

a second electrode;

a source of electrical current in electrical communication with the first electrode and the second electrode;

an electrolyte in fluid communication with the first electrode and the second electrode;

a gas, wherein the gas is formed during electrolysis at or near the first electrode; and

a separator;

wherein the first electrode comprises a topographical enhancement to control the location of nucleation of the gas by substantially separating the location of electron transfer and nucleation.

20. The electrolytic cell of claim 19 wherein the topographical enhancement increases the surface area of the first electrode.

21. The electrolytic cell of claim 20 wherein the topographical enhancement comprises filaments.

22. The electrolytic cell of claim 21 wherein the topographical enhancement comprises a metal.

23. The electrolytic cell of claim 21 wherein the topographical enhancement comprises a doped semiconductor.

24. The electrolytic cell of claim 21 wherein the topographical enhancement comprises carbon, silicon, carbon or boron nitride, or carbide.

25. The electrolytic cell of claim 19 wherein the separator comprises the first electrode and the topographical enhancement comprises a first conductive material proximal to the source of electrical current and a dielectric material distal to the source of electrical current.

26. The electrolytic cell of claim 25 wherein the topographical enhancement further comprises a second conductive material proximal to the dielectric material and distal to the source of electrical current.

27. The electrolytic cell of claim 19 wherein the separator comprises the first electrode.

28. The electrolytic cell of claim 27 wherein the separator further comprises a microorganism, and wherein the separator substantially retains the microorganism in a desired location.

What is claimed is:

1. An electrolytic cell comprising:

a containment vessel;

a first electrode;

a second electrode;

a source of electrical current in electrical communication with the first electrode and the second electrode;

an electrolyte in fluid communication with the first electrode and the second electrode;

a gas, wherein the gas is formed during electrolysis at or near the first electrode; and

a separator configured to permit liquid flow from one side of the separator to a second side of the separator;

wherein the separator comprises the first electrode and the first electrode comprises a first conductive material proximal to the source of electrical current and a dielectric material distal to the source of electrical current to control the location of nucleation of the gas by substantially separating the location of electron transfer and nucleation.

2. The electrolytic cell of claim **1** wherein first electrode further comprises a second conductive material proximal to the dielectric material and distal to the source of electrical current.

3. The electrolytic cell of claim **2** wherein the dielectric material comprises filaments.

4. The electrolytic cell of claim **3** wherein the dielectric material comprises a doped semiconductor.

5. The electrolytic cell of claim **3** wherein the dielectric material comprises carbon, silicon, carbon or boron nitride, or carbide.

6. The electrolytic cell of claim **2** wherein the separator further comprises a microorganism, and wherein the separator substantially retains the microorganism in a desired location.

7. An electrolytic cell comprising:

a containment vessel;

a first electrode wherein the first electrode comprises a topographical treatment to provide increased surface area wherein the topographical treatment comprises a

topographical enhancement wherein the topographical enhancement comprises carbon, silicon, carbon or boron nitride, or carbide;

a second electrode;

a source of electrical current in electrical communication with the first electrode and the second electrode;

an electrolyte in fluid communication with the first electrode and the second electrode;

a gas, wherein the gas is formed during electrolysis at or near the first electrode; and

a separator;

wherein the first electrode is configured to control the location of nucleation of the gas by substantially separating the location of electron transfer and nucleation.

8. The electrolytic cell of claim 7 wherein the topographical treatment comprises sandblasting, knurling, or electroplating with a catalytic nucleation agent.

9. The electrolytic cell of claim 7 wherein the topographical enhancement comprises filaments.

10. The electrolytic cell of claim 7 wherein the topographical enhancement comprises a metal.

11. The electrolytic cell of claim 7 wherein the topographical enhancement comprises a doped semiconductor.

12. The electrolytic cell of claim 7 wherein the separator comprises the first electrode and the first electrode comprises a first conductive material proximal to the source of electrical current and a dielectric material distal to the source of electrical current.

13. The electrolytic cell of claim **12** wherein the first electrode further comprises a second conductive material proximal to the dielectric material and distal to the source of electrical current.

14. The electrolytic cell of claim 7 wherein the separator comprises the first electrode.

15. The electrolytic cell of claim **14** wherein the separator further comprises a microorganism, and wherein the separator substantially retains the microorganism in a desired location.

16. An electrolytic cell comprising:

a containment vessel;

a first electrode;

a second electrode;

a source of electrical current in electrical communication with the first electrode and the second electrode;

an electrolyte in fluid communication with the first electrode and the second electrode;

a gas, wherein the gas is formed during electrolysis at or near the first electrode; and

a separator configured to permit liquid flow therethrough;

wherein the first electrode comprises a topographical enhancement to control the location of nucleation of the gas by substantially separating the location of electron transfer and nucleation.

17. The electrolytic cell of claim **16** wherein the topographical enhancement increases the surface area of the first electrode.

18. The electrolytic cell of claim **17** wherein the topographical enhancement comprises filaments.

19. The electrolytic cell of claim **18** wherein the topographical enhancement comprises a metal.

20. The electrolytic cell of claim **18** wherein the topographical enhancement comprises a doped semiconductor.

21. The electrolytic cell of claim **18** wherein the topographical enhancement comprises carbon, silicon, carbon or boron nitride, or carbide.

22. The electrolytic cell of claim **16** wherein the separator comprises the first electrode and the topographical enhancement comprises a first conductive material proximal to the source of electrical current and a dielectric material distal to the source of electrical current.

23. The electrolytic cell of claim **22** wherein the topographical enhancement further comprises a second conductive material proximal to the dielectric material and distal to the source of electrical current.

24. The electrolytic cell of claim **16** wherein the separator comprises the first electrode.

25. The electrolytic cell of claim **24** wherein the separator further comprises a microorganism, and wherein the separator substantially retains the microorganism in a desired location.