CLAIMS

What is claimed is:

1. A method for producing electricity in a molten carbonate fuel cell, the method comprising: introducing an anode input stream comprising H_2, a reformable fuel, or a combination thereof into an anode gas collection zone, the anode gas collection zone being defined by an anode surface, a first separator plate, and an anode collector providing support between the anode surface and the first separator plate; introducing a cathode input stream comprising O_2, H_2O, and CO_2 into a cathode gas collection zone, the cathode gas collection zone being defined by a cathode surface, a second separator plate, and a cathode collector providing support between the cathode surface and the second separator plate; operating the molten carbonate fuel cell at a transference of 0.97 or less and an average current density of 60 mA/cm^2 or more to generate electricity, an anode exhaust comprising H_2, CO, and CO_2, and a cathode exhaust comprising 2.0 vol% or less CO_2, 1.0 vol% or more O_2, and 1.0 vol% or more H_2O, wherein an average cathode gas lateral diffusion length is 0.40 mm or less, or an open area of the cathode surface comprises 45% or more of a total surface area of the cathode surface, or a combination thereof.

2. The method of claim 1, wherein the cathode input stream comprises 5.0 vol% or less of CO_2, or wherein the cathode exhaust comprises 1.0 vol% or less of CO_2, or a combination thereof.

3. The method of any of the above claims, wherein the transference is 0.95 or less .

4. The method of any of the above claims, wherein an average contact area diffusion length is 1.0 mm or less , or a contact area of the cathode collector with the cathode surface is greater than 10% of the total surface area of the cathode surface, or a combination thereof, wherein the average contact area diffusion length is defined as the average lateral distance from a contact area location on a cathode surface to each point on the cathode surface.

5. The method of any of the above claims, wherein an average cathode gas lateral diffusion length is 0.4 mm or less, or a contact area of the cathode collector with the cathode surface is greater than 10% of the total surface area of the cathode surface, or a combination thereof.

6. The method of any of the above claims, wherein the cathode surface comprises one or more grooves.

7. The method of claim 6, wherein 2% or more of the open surface area corresponds to the one or more grooves.

8. The method of any of the above claims, wherein the cathode collector further comprises an open lattice structure with a lattice size of 0.1 mm or less in contact with the cathode surface and a spacing structure providing support between the open lattice structure and the second separator plate.

9. The method of any of the above claims, wherein the voltage drop across the cathode is 0.4 V or less, or wherein the electricity is generated at a voltage of 0.55 V or more, or a combination thereof.

10. The method of any of the above claims, wherein the open area of the cathode surface is 50% or more, or wherein the average cathode gas lateral diffusion length is 0.35 mm or less, or a combination thereof.

11. The method of any of the above claims, wherein a H_2 concentration in the anode exhaust is 5.0 vol% or more, or wherein a combined concentration of H_2 and CO in the anode exhaust is 6.0 vol% or more, or a combination thereof.

12. The method of any of the above claims, wherein a distance from any point on the cathode surface to an open area on the cathode surface is 1.0 mm or less.

13. A molten carbonate fuel cell, comprising: an anode; a first separator plate; an anode collector in contact with the anode and the first separator plate to define an anode gas collection zone between the anode and the first separator plate; a cathode; a second separator plate; a cathode collector in contact with the cathode and the second separator plate to define a cathode gas collection zone between the cathode and the second separator plate; and an electrolyte matrix comprising an electrolyte between the anode and the cathode, wherein an average cathode gas lateral diffusion length is 0.40 mm or less, or an open area of the cathode surface is greater than 45% of a total surface area of the cathode surface, or a combination thereof,

wherein an open mesh screen having a mesh size of 1.0 mm or less average cell width and/or length is positioned between the cathode surface and the cathode collector, wherein a fuel stream having an CO_2 amount of at least 1 vol% is fed to the anode, and wherein operating the molten carbonate fuel cell results in a cathode exhaust comprising 2.0 vol% or less CO_2.

14. The molten carbonate fuel cell of claim 13, wherein an average contact area diffusion length is 1.0 mm or less, or a contact area of the cathode collector with the cathode surface is greater than 10% of the total surface area of the cathode surface, or wherein a distance from any point on the cathode surface to an open area on the cathode surface is 1.0 mm or less, or a combination thereof, wherein the average contact area diffusion length is defined as the average lateral distance from a contact area location on a cathode surface to each point on the cathode surface.

15. The molten carbonate fuel cell of claim 13 or 14, wherein the cathode surface comprises one or more grooves.

16. The molten carbonate fuel cell of claim 15, wherein at least 2% of the open surface area corresponds to the one or more grooves.

17. The molten carbonate fuel cell of any of claims 13-16, wherein the cathode collector comprises an open lattice structure with a lattice size of 0.1 mm or less in contact with the cathode surface and a spacing structure providing support between the open lattice structure and the second separator plate.