CLAIMS:

1. A fuel cell comprising:

a first electrochemical cell including a first anode and a first cathode;

a second electrochemical cell including a second anode and a second cathode; and

a ceramic interconnect configured to conduct a flow of electrons from the first anode to the second cathode, wherein the interconnect comprises a first ceramic layer and a second ceramic layer adjacent to the first ceramic layer, wherein the first ceramic layer is closer to the first anode than the second ceramic layer, and the second ceramic layer is closer to the second cathode than the first ceramic layer, wherein the first ceramic layer and second ceramic layer separate fuel gas on an anode side of the fuel cell from oxidant gas on a cathode side of the fuel cell,

wherein the first ceramic layer comprises one or more of doped ceria, doped lanthanum chromite, and doped yttrium chromite,

wherein the second ceramic layer comprises one or more of a Co-Mn spinel and a ABO_3 perovskite, and

wherein the first ceramic layer and the second ceramic layer are adjacent to each other along an interface, wherein the first ceramic layer defines a first thickness and the second ceramic layer defines a second thickness, wherein the first thickness and second thickness control the pO_2 at the interface of the first and second ceramic layers in a range of $1.01325e^{-6}$ to $1.01325e^{-9}$ pascal.

2. The fuel cell of claim 1, wherein the first ceramic layer comprises doped ceria having the chemical formula $(R_xCe_{1-x})O_2$, where R is a rare earth metal, $0 < x \leq 0.5$.

3. The fuel cell of claim 1, wherein the first ceramic layer comprises doped ceria having the chemical formula $(R_x M_y Ce_{1-x-y})O_2$, where R is a rare earth metal, M is a transition metal, $0 < x \leq 0.5$ and $0 \leq y < 0.1$.

4. The fuel cell of claim 1, wherein the first ceramic layer comprises doped ceria having the chemical formula $w(R_x M_y Ce_{1-x-y})O_2 - (1-w)N$, where R is a rare earth metal, M is a transition metal, N is an alkali metal or alkaline earth metal, $0 < x \leq 0.5$, $0 \leq y < 0.1$, and $0 < w \leq 0.1$.

5. The fuel cell of claim 1, wherein the first ceramic layer comprises a doped ceria-perovskite composite material.

6. The fuel cell of claim 5, wherein the perovskite comprises $SrTiO_3$ or $(Sr_{1-x}A_x)(Ti_{1-y}M_y)O_3$, where A is an alkaline metal or rare earth metal, and M is a transition metal.

7. The fuel cell of claim 5, wherein the perovskite comprises doped lanthanum chromite having the chemical formula $(La_{1-x}A_x)(Cr_{1-y}M_y)O_3$, where A is an alkaline metal, M is a transition metal, and $0 < x \leq 0.3$.

8. The fuel cell of claim 1, wherein the first ceramic layer comprises doped lanthanum chromite having the chemical formula $(La_{1-x}A_x)(Cr_{1-y}M_y)O_3$, where A is an alkaline metal, M is a transition metal, and $0 < x \leq 0.3$, $0 < y \leq 0.5$.

9. The fuel cell of claim 1, wherein the second ceramic layer comprises a (Mn, Co, A)$_3O_4$ spinel, where A is a transition metal.

10. The fuel cell of claim 1, wherein the second ceramic layer comprises the ABO_3 perovskite, wherein the ABO_3 perovskite comprises one or more of LSM ($(La_{1-x}Sr_x)MnO_3$), LNF ($La(Ni_{1-y}Fe_y)O_3$, PSM ($(Pr_{1-x}Sr_x)MnO_3$), LSC ($(La_{1-x}Sr_x)CoO_3$), LSCF ($(La_{1-x}Sr_x)(Co_{1-y}Fe_y)O_3$), and R-P nickelate, such as Pr_2NiO_4.

11. The fuel cell of claim 1, wherein the second ceramic layer comprises a (Mn, Co, $A_x)_3O_4$ spinel - ABO_3 perovskite composite, where A is a transition metal, and $0 \leq x \leq 0.1$.

12. The fuel cell of claim 11, wherein the composite comprises one or more of (Mn, Co, $A_x)_3O_4$ – LNF and (Mn, Co, $A_x)_3O_4$ – LSM.

13. The fuel cell of claim 1, wherein the second ceramic layer comprises a (Mn, Co, $A_x)_3O_4$ spinel – ionic phase composite, where A is a transition metal, and $0 \leq x \leq 0.1$.

14. The fuel cell of claim 13, wherein the ionic phase comprises one or more of doped ceria, Y or Sc stabilized zirconia.

15. The fuel cell of claim 1, wherein the first ceramic layer defines a first thickness and the second ceramic layer defines a second thickness, wherein the first thickness is in the range of about 5 to about 100 micrometers, and the second thickness is in the range of about 5 to about 50 micrometers.

16. The fuel cell of claim 1, wherein the second ceramic layer comprises a (Mn, $Co)_3O_4$ spinel.

17. The fuel cell of claim 1, wherein the first ceramic layer consists essentially of the one or more of doped ceria, doped lanthanum chromite, and doped yttrium chromite.

18. The fuel cell of claim 1, wherein the second ceramic layer consists essentially of the one or more of a Co-Mn spinel and a ABO_3 perovskite.

19. The fuel cell of claim 1, wherein the first ceramic layer consists essentially of the one or more of doped ceria, doped lanthanum chromite, and doped yttrium chromite,

and wherein the second ceramic layer consists essentially of the one or more of a Co-Mn spinel and a ABO_3 perovskite.

20. A method for manufacturing a fuel cell, the method comprising forming a fuel cell structure, the structure comprising:

a first electrochemical cell including a first anode and a first cathode;

a second electrochemical cell including a second anode and a second cathode; and

a ceramic interconnect configured to conduct a flow of electrons from the first anode to the second cathode, wherein the interconnect comprises a first ceramic layer and a second ceramic layer adjacent to the first ceramic layer, wherein the first ceramic layer is closer to the anode than the second ceramic layer, and the second ceramic layer is closer to the cathode than the first ceramic layer, wherein the first ceramic layer and second ceramic layer separate fuel gas on an anode side of the fuel cell from oxidant gas on the cathode side of the fuel cell,

wherein the first ceramic layer comprises one or more of doped ceria, doped lanthanum chromite, and doped yttrium chromite,

wherein the second ceramic layer comprises one or more of a Co-Mn spinel and a ABO_3 perovskite, and

wherein the first ceramic layer and the second ceramic layer are adjacent to each other along an interface, wherein the first ceramic layer defines a first thickness and the second ceramic layer defines a second thickness, wherein the first thickness and second thickness control the pO_2 at the interface of the first and second ceramic layers in a range of $1.01325e^{-6}$ to $1.01325e^{-9}$ pascal.