What is claimed is:

1. A membrane for the dehydration of a gas, comprising:

a porous support;

a composite comprising a graphene oxide compound and an ammonium salt polymer;

wherein the composite is coated on the porous support; and

wherein the membrane has high moisture permeability and low gas permeability.

2. The membrane of claim 1, wherein the membrane has a moisture permeability of greater than 1 $x10^{-5}$ $g/m^2 \cdot s \cdot Pa$ and gas permeability of less than 1 $x10^{-8}$ $L/m^2 \cdot s \cdot Pa$.

3. The membrane of claim 1 or 2, wherein the ammonium salt polymer is a poly(diallyldimethylammonium) salt.

4. The membrane of claim 1, 2, or 3, wherein the ammonium salt polymer is poly(diallyldimethylammonium) chloride.

5. The membrane of claim 1, 2, 3, or 4, wherein the porous support comprises polypropylene, polyethylene terephthalate, polysulfone, or polyether sulfone.

6. The membrane of claim 1, 2, 3, 4, or 5, further comprising polyvinyl alcohol.

7. The membrane of claim 6, wherein the graphene oxide compound and the polyvinyl alcohol are crosslinked.

8. The membrane of claim 6 or 7, wherein the weight ratio of the graphene oxide compound to polyvinyl alcohol is from about 0.1:100 to about 9:1.

9. The membrane of claim 1, 2, 3, 4, 5, 6, 7, or 8, wherein the graphene oxide compound comprises graphene oxide, reduced graphene oxide, functionalized graphene oxide, or functionalized and reduced graphene oxide.

10. The membrane of claim 1, 2, 3, 4, 5, 6, 7, 8, or 9, wherein the graphene oxide compound has a platelet size from about 0.05 μm to about 100 μm.

11. The membrane of claim 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10, further comprising an alkaline earth metal.

12. The membrane of claim 11, wherein the alkaline earth metal comprises calcium chloride.

13. The membrane of claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12, further comprising a surfactant.

14. The membrane of claim 13, wherein the surfactant is sodium lauryl sulfate.

15. The membrane of claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, or 14, wherein the composite is a layer that has a thickness of about 1 μm to about 200 μm.

16. The membrane of claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, or 15, further comprising a protective layer.

17. A method of dehydrating a gas, comprising:

introducing a first gas containing water vapor to a first side of the membrane of claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, or 16;

wherein the water vapor pressure on the first side of the membrane is higher than the water vapor pressure on the second side of the membrane and water vapor from the first gas passes through the membrane from the first side to the second side;

wherein the retained gas is retained on the first side of the membrane to generate a second gas; and

wherein the second gas has a lower water vapor pressure than the first gas.

18. The method of claim 17, further comprising a sweep gas on the second side of the membrane that removes water vapor.

19. A method for making a membrane for the dehydration of a gas, comprising

annealing and drying a coating on a treated support;

wherein the support is corona treated;

wherein the coating is a mixture comprising 1) graphene oxide, and 2) PVA, PDADMA, SLS, $CaCl_2$, or any combination thereof.

20. The method of claim 19, further comprising a protective layer.