CLAIMS

What is claimed is:

1. A porous polyethylene membrane comprises:

a first side;

an opposing second side; and

a thickness between the first and second sides, the membrane exhibiting a log 10 flow time (seconds) relative to mean bubble point (pounds per square inch) that is 5 percent less to 10 percent less than a log 10 flow time relative to mean bubble point according to the equation:

$$\log 10(\text{flow time}) = 2.757 + 0.007105 * (\text{mean bubble point})$$

wherein:

flow time is measured using the Flow Time Test, and

mean bubble point is measured using the Mean Bubble Point Test.

2. The membrane of claim 1, wherein the membrane exhibits a log 10 flow time (seconds) relative to mean bubble point (pounds per square inch) that is less than or equal to a log 10 flow time relative to mean bubble point according to the equation:

$$\log 10(\text{flow time}) = 2.707 + 0.006485 * (\text{mean bubble point}).$$

3. The membrane of claim 1 or 2, wherein

the first side comprises polyethylene having a first average molecular weight,

the second side comprises polyethylene having a second average molecular weight, and

the first molecular weight is equal to the second molecular weight.

4. The membrane of any preceding claim, wherein the membrane has a thickness in a range from 30 to 200 microns.

5. The membrane of claim 2, wherein the membrane exhibits a log 10 flow time (seconds) relative to mean bubble point (pounds per square inch) that is 5 percent less than a log 10 flow time relative to mean bubble point according to the equation:

$$\log 10(\text{flow time}) = 2.707 + 0.006485 * (\text{mean bubble point}).$$

6. The membrane according to any preceding claim, wherein the membrane exhibits a log 10 flow time (seconds) relative to the mean bubble point (pounds per square inch) that is greater than or equal to a log 10 flow time relative to mean bubble point according to the equation:

$$\log 10(\text{flow time}) = 2.4888 + 0.006593 * (\text{mean bubble point}).$$

7. A filter cartridge comprising a membrane of any of the preceding claims, the filter cartridge comprising a filter housing comprising an inlet, an outlet, and the membrane supported within the housing between the inlet and the outlet such that liquid entering the inlet passes through the membrane before passing through the outlet.

8. A method of using a filter cartridge of claim 7, the method comprising causing fluid to flow into the inlet, through the membrane, and out the outlet, wherein the fluid is useful in a semiconductor manufacturing processes.

9. A method of preparing a co-extruded, porous polyethylene membrane having a first side and an opposing second side and a thickness between the first and second sides, with pores throughout the thickness, the method comprising:

co-extruding a first heated liquid polymer solution and a second heated liquid polymer solution, the first polymer solution comprising polyethylene in liquid solvent, and the second polymer solution comprising polyethylene in liquid solvent, and

reducing temperature of the co-extruded liquid polymer solutions to cause the polymer of the liquid polymer solutions to coagulate to form the membrane, the membrane comprising a tight side formed from the first polymer solution and an open side formed from the second polymer solution,

the membrane exhibiting a log 10 flow time (seconds) relative to mean bubble point (pounds per square inch) that is 5 percent less to 10 percent less than a log 10 flow time relative to mean bubble point according to the equation:

$$\log 10(\text{flow time}) = 2.757 + 0.007105^{*} (\text{mean bubble point})$$

wherein flow time is measured using the Flow Time Test and mean bubble point is measured using the Mean Bubble Point Test.

10. The method of claim 9, further comprising extruding the first polymer solution at a flow rate in a range from 15 to 40 percent of the total flow rate (mass per time) of the first polymer solution and the second polymer solution.

11. The method of claim 9 or 10, further comprising:

extruding the first polymer solution having a first concentration of polymer in the first polymer solution, and

extruding the second polymer solution having a second concentration of polymer in the second polymer solution,

wherein the first concentration is greater than the second concentration.

12. The method of any of claims 9 through 11, further comprising:

co-extruding the first heated polymer solution and the second heated polymer solution at an extrusion temperature, and

reducing temperature of the co-extruded heated polymer solutions by contacting the first heated polymer solution with a surface that has a temperature that is below the extrusion temperature.

13. The method of any of claims 9 through 12, wherein:

the first heated polymer solution forms a tight layer of the membrane having pores having an average pore size, and

the second heated polymer solution forms an open layer of the membrane having pores having an average pore size that is greater than the average pore size of the pores of the tight porous portion.

14. The method of any of claims 9 through 13, wherein the membrane has a thickness in a range from 30 to 200 microns.

15. The method of any of claims 9 through 14, wherein:

the first side comprises polyethylene having an average molecular weight in a range from 500,000 Dalton to 3,000,000 Dalton, and

the second side comprises polyethylene having an average molecular weight in a range from 500,000 Dalton to 3,000,000 Dalton.

16. The method of any of claims 9 through 15, wherein

the first side comprises polyethylene having an average molecular weight in a range from 500,000 Dalton to 2,000,000 Dalton, and

the second side comprises polyethylene having an average molecular weight in a range from 500,000 Dalton to 2,000,000 Dalton.

17. The method of any of claims 9 through 16, wherein the membrane exhibits a log 10 flow time (seconds) relative to mean bubble point (pounds per square inch) that is less than or equal to a log 10 flow time relative to mean bubble point according to the equation:

$$\log 10(\text{flow time}) = 2.707 + 0.006485 * (\text{mean bubble point}).$$

18. A method of preparing a filter cartridge, the method comprising:

preparing a membrane according to a method of any of claims 10 through 18, and

installing the membrane in a filter housing that comprises an inlet, an outlet, and the membrane supported within the housing between the inlet and the outlet such that liquid entering the inlet passes through the membrane before passing through the outlet.

19. The method of claim 18, wherein the membrane is prepared by a co-extrusion method as described and is unstretched when installed in the filter housing.