

What is claimed is:

1. A blending system for maintaining a mixture at a desired concentration comprising:
 - a first species input that provides a first species;
 - a second species input that provides a second species;
 - 5 a blending unit in fluid communication with the first species input, the second species input, and an output that is in fluid communication with at least one point of use, wherein the blending unit is configured to blend the first species and the second species thereby forming a mixture;
 - a first metrology system configured to measure a concentration of the first species in the first
 - 10 species input;
 - a second metrology system configured to measure a concentration of the second species in the second species input; and
 - a controller in electronic communication with the blending unit, the first metrology system, and the second metrology system, wherein the controller is configured to:
 - 15 determine a mass balance to maintain a concentration in the mixture within 1% of a concentration range using information from the first metrology system, the second metrology system, and a flow in the output to the at least one point of use; and
 - maintain the concentration in the mixture within 1% of the concentration range by controlling a flow rate for at least one of the first species or the second species to the
 - 20 blending unit based on the mass balance.
2. The blending system of claim 1, further comprising:
 - a first species source in fluid communication with the first species input, wherein the first
 - species source provides the first species; and
 - a second species source in fluid communication with the second species input, wherein the
 - 25 second species source provides the second species.
3. The blending system of claim 1, further comprising an output metrology system in the blending unit, wherein the output metrology system is configured to measure the concentration in the mixture upstream of the point of use, wherein the output metrology system is in electronic communication with the controller, and wherein the controller uses
- 30 information from the output metrology system to determine the mass balance.

4. The blending system of claim 1, wherein the system further comprises a plurality of the points of use each having one of a plurality of the outputs.
5. The blending system of claim 1, wherein the controller is further configured to:
receive information related to a demand rate at the point of use; and
5 increase a flow rate of the mixture from the blending unit to the point of use while maintaining the concentration within 1% of the concentration range.
6. The blending system of claim 1, wherein the controller is further configured to:
receive information related to a demand rate at the point of use; and
decrease a flow rate of the mixture from the blending unit to the point of use while
10 maintaining the concentration within 1% of the concentration range.
7. The blending system of claim 1, wherein the blending unit is configured to achieve a homogenous solution of the mixture at less than 99% of a maximum designed flow rate for the system.
8. The blending system of claim 1, wherein the blending unit comprises:
15 an input flow path;
an output flow path;
a chemical injection nozzle proximate the input flow path, wherein the chemical injection nozzle includes an insertable injection nozzle;
a directional flow perforated plate downstream of the input flow path and the chemical
20 injection nozzle;
a homogenizing turbulence mix zone void disposed downstream of the input flow path and the chemical injection nozzle and upstream of the directional flow perforated plate;
a flow directional cone disposed downstream of the input flow path and the chemical injection nozzle and upstream of the homogenizing turbulence mix zone void;
25 a first mixing zone flow directional cone disposed downstream of the homogenizing turbulence mix zone void and upstream the directional flow perforated plate; and
a turbulence break void disposed between the directional flow perforated plate and the output flow path.
9. The blending system of claim 1, further comprising a directional valve in fluid
30 communication with the blending unit, wherein the controller is in electronic communication

with the directional valve, and wherein the controller is configured to control the directional valve to circulate or drain the mixture in the blending unit.

10. The blending system of claim 9, further comprising a heater, a pressure control, and a pump in fluid communication with the blending unit between the blending unit and the output.
- 5 11. The blending system of claim 1, wherein the blending system is configured to provide the mixture to the output at a plurality of flow rates sequentially over a period of time, and wherein the concentration in the mixture is within 1% of the concentration range for the plurality of flow rates.
- 10 12. The blending system of claim 1, wherein the controller is configured to control the blending unit and a flow rate of the mixture to the output such that a first species in the mixture from the first species input is maintained within a range of approximately 0.01% to approximately 0.1% of the concentration range and such that a second species in the mixture from the second species input is maintained within a range of approximately 0.01% to approximately 0.1% of the concentration range.
- 15 13. The blending system of claim 1, further comprising a third species input in fluid communication with the blending unit and a third metrology system in electronic communication with the controller, wherein the third species input provides a third species for the mixture, wherein the third metrology system is configured to measure a concentration of the third species in the third species input, and wherein the concentration of the third
20 species is used in the mass balance.
14. The blending system of claim 1, further comprising an ultra-pure water input in fluid communication with the blending unit.
15. The blending system of claim 1, wherein the point of use is a semiconductor processing tool.
16. A method of providing a blended mixture to a point of use comprising:
25 providing a flow of a first species to a blending unit;
providing a flow of a second species to the blending unit;
blending the first species and the second species in the blending unit to produce a mixture;
distributing the mixture to a point of use via an output in fluid communication with the
blending unit;

- measuring a concentration of the first species in the flow of the first species with a first metrology system;
measuring a concentration of the second species in the flow of the second species with a second metrology system; and
5 maintaining, using a controller in electronic communication with the first metrology system and second metrology system, a concentration in the mixture within 1% of a concentration range based on a mass balance, wherein the maintaining includes determining the mass balance to maintain the concentration in the mixture within 1% of the concentration range using information from the first metrology system, the second
10 metrology system, and a flow in the output to the at least one point of use.
17. The method of claim 16, wherein the blending unit delivers the mixture on-demand to the point of use.
18. The method of claim 16, wherein the maintaining includes, using the controller, changing a flow rate of the flow of the first species or a flow rate of the second species.
- 15 19. The method of claim 16, wherein the maintaining includes, using the controller, increasing a flow of the mixture when the concentration in the mixture is outside the concentration range.
20. The method of claim 19, wherein increasing the flow includes opening a drain valve in fluid communication with the blending unit.
21. The method of claim 16, further comprising measuring the concentration in the mixture
20 upstream of the point of use with an output metrology system, wherein information from the output metrology system is used to determine the mass balance.
22. The method of claim 16, wherein determining the mass balance to maintain the concentration in the mixture includes using information about concentration of the mixture from the point of use.
- 25 23. The method of claim 16, further comprising increasing at least one of the flow of the first species or the second species when the concentration in the mixture is outside the concentration range.

24. The method of claim 16, further comprising decreasing at least one of the flow of the first species or the second species when the concentration in the mixture is outside the concentration range.
25. The method of claim 16, wherein the system is configured to provide the mixture to the point
5 of use at a plurality of flow rates sequentially over a period of time, and wherein the concentration in the mixture is within 1% of the concentration range for the plurality of flow rates.
26. The method of claim 25, wherein each of the plurality of flow rates are from 1 liter per minute to 20 liters per minute.
- 10 27. The method of claim 16, wherein distributing the mixture is to a plurality of the points of use.
28. The method of claim 16, wherein the maintaining includes compensating for decomposition of the first species or the second species in the blending unit.
29. The method of claim 16, further comprising:
providing a flow of a third species to the blending unit; and
15 measuring a concentration of the third species in the flow of the third species with a third metrology system that is in electronic communication with the controller;
wherein determining the mass balance uses the concentration of the third species from the third metrology system.
30. The method of claim 29, wherein the third species decomposes at least one of the first
20 species or the second species in the mixture.
31. The method of claim 16, further comprising providing a flow of ultra-pure water to the blending unit.
32. The method of claim 16, wherein the first species and the second species are each an aqueous acid, base, solvent, salt, or slurry.