

WHAT IS CLAIMED IS:

1. An inline particle sensor comprising:
  - a sensor head configured to mount within a fitting, the sensor head including a laser source configured to emit a laser beam through a sensing volume and a detector arranged to detect laser light scattered by particles in the sensing area passing through the laser beam; and
  - electronics coupled to the sensor head and configured to receive a signal from the detector indicative of light scattered from by particles and provide a particle output based on the signal.
2. The inline particle sensor of claim 1, wherein the laser beam in the sensing volume is configured to provide a large cross-sectional area to a predominant direction of flow of particles through the sensing volume.
3. The inline particle sensor of claim 2, wherein the laser beam in the sensing volume is configured to provide a region of illumination that is thin parallel to the predominant direction of flow of particles, creating a laminar illuminated region.
4. The inline particle sensor of claim 1, wherein a predominant axis of scattered light detection is approximately orthogonal to a predominant direction of particle flow and simultaneously approximately orthogonal to a predominant laser beam direction.
5. The inline particle sensor of claim 1, wherein a polarization of the laser light in the sensing volume is perpendicular to a predominant axis of scattered light detection.
6. The inline particle sensor of claim 1, wherein the laser source emits a wavelength or wavelengths within the band from vacuum UV to about 480 nm.
7. The inline particle sensor of claim 1, and further comprising a laser interlock.
8. The inline particle sensor of claim 7, wherein the laser interlock is a vacuum switch configured to close below a selected vacuum threshold.
9. The inline particle sensor of claim 7, wherein the laser interlock includes a pressure sensor.
10. The inline particle sensor of claim 1, and further comprising a flow restrictor configured to direct particle flow through the sensing area.
11. The inline particle sensor of claim 1, wherein the fitting is coupled to a vacuum pump line between a vacuum pump and a process chamber.

12. The inline particle sensor of claim 1, wherein the fitting is coupled to a vacuum pump line between a low-pressure vacuum pump and a high-pressure vacuum pump.
13. The inline particle sensor of claim 1, wherein the electronics are externally coupled to the sensor head.
14. The inline particle sensor of claim 1, wherein the electronics are contained within the sensor head.
15. An inline particle sensor system comprising:
  - a vacuum pump;
  - a vacuum pump line;
  - a process chamber;
  - a fitting fluidically coupled to the vacuum pump line between the vacuum pump and the process chamber;
  - an inline particle sensor coupled to the fitting and configured to sense scattered light of particles within the sensor system and generate a sensor signal indicative of the presence of the particles; and
  - electronics coupled to the vacuum particle sensor configured to receive the sensor signal and generate a particle output based on the sensor signal.
16. The inline particle sensor system of claim 15, wherein the vacuum pump is a first vacuum pump and comprises either a low-pressure vacuum pump or a high-pressure vacuum pump.
17. The inline particle sensor system of claim 16, further comprising a second vacuum pump that is either a low-pressure vacuum pump or a high-pressure vacuum pump.
18. The inline particle sensor system of claim 17, wherein the fitting is fluidically coupled to the vacuum pump line between the first vacuum pump and the second vacuum pump.
19. The inline particle sensor system of claim 15, wherein the inline particle sensor comprises a laser source configured to emit a laser at a wavelength from UV to about 480 nm.
20. The inline particle sensor system of claim 19, wherein the laser source has an output power of about 3.5 watts.
21. The inline particle sensor system of claim 15, and further comprising a second inline particle sensor coupled to a second fitting, wherein the second fitting is fluidically coupled to the vacuum pump line between the vacuum pump and the process chamber.

22. The inline particle sensor system of claim 15, further comprising at least one additional vacuum pump line, the at least one additional vacuum pump line comprising:
- an additional vacuum pump;
  - an additional fitting fluidically coupled to the at least one additional vacuum pump line between the additional vacuum pump and process chamber;
  - an additional inline particle sensor coupled to the fitting and configured to sense an additional scattered light of the particles within the sensor system and generate an additional sensor signal indicative of the additional characteristic of the particles;
  - and
  - additional electronics coupled to the inline particle sensor configured to receive the additional sensor signal and generate an additional particle output based on the based on the additional sensor signal.
23. An inline particle sensor system comprising:
- a process chamber;
  - a vacuum pump line coupled to the process chamber and configured to allow fluid flow from the process chamber into the vacuum pump line;
  - a first vacuum pump coupled to the vacuum pump line;
  - a second vacuum pump coupled to the vacuum pump line;
  - a fitting fluidically coupled to the vacuum pump line between the first and second vacuum pumps and between one of either the first or second vacuum pumps and the process chamber;
  - an inline particle sensor coupled to the fitting and configured to sense scattered light of particles within the system and generate a sensor signal indicative of the presence of particles; and
  - electronics coupled to the sensor configured to receive the sensor signal and determine a particle output based on the sensor signal.