CLAIMS

1. A handheld laser system, comprising:

a laser source configured to generate laser radiation at a wavelength for performing a material processing operation on a workpiece material with a laser beam of the generated laser radiation;

a plasma sensor configured to detect plasma emitted from the workpiece material during a material processing operation; and

a controller coupled to the plasma sensor and configured to:

compare an optical intensity value obtained by the plasma sensor to a threshold value at a time when a predetermined time period has elapsed after the material processing operation has commenced; and

produce a control command based on the comparison.

2. The handheld laser system of claim 1, wherein the control command

turns off power to the laser source when the optical intensity value is lower than the threshold value, and

maintains power to the laser source when the optical intensity value is at or greater than the threshold value.

~~3. The handheld laser system of claim 2, wherein the predetermined time period is at least 100 microseconds (µs).~~

43. The handheld laser system of claim 1, further comprising at least one optical filter configured to block light at the wavelength of the emitted laser light from reaching the plasma sensor.

54. The handheld laser system of claim 1, further comprising an air-cooling system coupled to the laser source for dissipating heat.

~~6. The handheld laser system of claim 5, further comprising a laser module that houses the laser source, the air-cooling system, and the controller.~~

~~7. The handheld laser system of claim 6, wherein the laser module is configured to be mounted to a movable cart.~~

~~8~~5. The handheld laser system of claim 1, further comprising a housing configured as a handheld apparatus having an outlet for the laser beam.

~~9~~6. The handheld laser system of claim ~~8~~5, wherein the handheld apparatus is of one-piece construction.

~~10~~7. The handheld laser system of claim ~~8~~5, wherein the handheld apparatus is configured with a modular attachment system for a nozzle.

~~11~~8. The handheld laser system of claim ~~8~~5, wherein the handheld apparatus is configured to be gas-cooled.

~~12~~9. The handheld laser system of claim ~~8~~5, wherein the handheld apparatus is configured to weigh less than about 1 kilogram (kg).

~~13. The handheld laser system of claim 8, wherein the plasma sensor is positioned within an interior of the handheld apparatus.~~

~~14~~10. The handheld laser system of claim ~~8~~5, further comprising an optical fiber coupling the handheld apparatus to the laser source.

~~15. The handheld laser system of claim 8, wherein the handheld apparatus comprises a trigger coupled to at least one of the controller and a source of shield gas that controls activation of the shield gas.~~

~~16. The handheld laser system of claim 15, wherein the trigger is a first trigger and the handheld apparatus further comprises a second trigger coupled to at least one of the controller and the laser source that controls activation of the laser source.~~

~~17. The handheld laser system of claim 16, wherein the first and second triggers are configured in a two-stage arrangement such that the second trigger will not activate the laser source unless the first trigger is activated.~~

~~18~~11. The handheld laser system of claim ~~8~~5, further comprising at least one movable mirror positioned within the housing, the at least one movable mirror configured to wobble the laser beam.

~~19~~12. The handheld laser system of claim 1, wherein the laser beam has a power of at least 1 kW.

~~20. The handheld laser system of claim 19, wherein the laser beam has a power of about 1.5 kW.~~

~~21~~13. The handheld laser system of claim 1, wherein the laser beam has a power within a range of 500 W to 3 kW inclusive.

~~22. The handheld laser system of claim 1, wherein the laser source is configured to:~~

~~generate laser radiation in a continuous wave (CW) mode that has an output power; and~~

~~generate laser radiation in a high peak power (HPP) mode characterized by having a maximum peak power that is less than twice the output power of the CW mode, a maximum duty cycle of about 20%, and a maximum pulse repetition frequency of about 1500 Hz.~~

~~23. The handheld laser system of claim 1, wherein the wavelength is infrared (IR) light and the at least one optical filter is configured as an IR suppression filter.~~

~~24~~14. A method, comprising:

directing a laser beam from a laser source onto a workpiece material;

activating a plasma sensor configured to detect plasma emitted from the workpiece material during a material processing operation;

comparing an optical intensity value obtained by the plasma sensor to a threshold value at a time when a predetermined time period has elapsed after the material processing operation has commenced; and

producing a control command based on the comparison.

~~25~~15. The method of claim ~~24~~14, wherein the control command powers off the laser source when the optical intensity value is lower than the threshold value and maintains power to the laser source when the optical intensity value is at or greater than the threshold value.

~~26. The method of claim 24, further comprising positioning at least one optical filter configured to block light at a wavelength of the laser source such that light at the wavelength of the laser source does not reach the plasma sensor.~~

~~27~~16. The method of claim ~~24~~14, further comprising providing a housing configured as a handheld apparatus having an outlet for the laser beam.

~~28. The method of claim 24, further comprising providing an optical fiber that couples the handheld apparatus to the laser source.~~

~~29~~17. The method of claim ~~24~~14, further comprising wobbling the laser beam.

~~30~~18. A handheld laser system, comprising:

a laser source configured to generate laser radiation at a wavelength for performing a material processing operation on a workpiece material with a laser beam of the generated laser radiation; and

a housing configured as a handheld apparatus having an outlet for the laser beam, the handheld apparatus configured to be gas-cooled.

~~31~~19. The handheld laser system of claim ~~30~~18, further comprising an optical fiber coupling the handheld apparatus to the laser source.

~~32~~20. The handheld laser system of claim ~~30~~18, wherein the handheld apparatus is of one-piece construction.

~~33~~21. The handheld laser system of claim ~~30~~18, wherein the handheld apparatus is configured with a modular attachment system for a nozzle.

~~34~~22. The handheld laser system of claim ~~30~~18, further comprising an air-cooling system coupled to the laser source for dissipating heat.

~~35. The handheld laser system of claim 34, further comprising a laser module that houses the laser source, the air-cooling system, and the controller.~~

~~36. The handheld laser system of claim 35, wherein the laser module is configured to be mounted to a movable cart.~~

~~37~~23. The handheld laser system of claim ~~30~~18, wherein the laser beam has a power of at least 1 kW.