

CLAIMS

What is claimed is:

1. A directed energy deposition additive manufacturing system comprising:
a logic, a standoff distance measurement unit, a substrate, a torch, a feed unit, a material, and a mover, wherein logic causes the feed unit to output the material and the torch to output a plasma such that the plasma melts the material onto the substrate and a workpiece is thereby additively manufactured on the substrate, wherein the workpiece has a geometric profile, wherein the torch is vertically spaced apart from the workpiece such that a standoff distance is defined, wherein the logic causes the standoff distance measurement unit to monitor the geometric profile while the workpiece is being additively manufactured such that the logic causes the mover to move at least one of the torch relative to the substrate or the substrate relative to the torch in order to maintain the standoff distance.
2. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance measurement unit includes a laser source and a camera, wherein the logic causes the laser source to output a laser pattern onto the geometric profile such that a plurality of reflections are generated, wherein the logic causes the camera to read the reflections, wherein the standoff distance measurement unit monitors the geometric profile based on the reflections.
3. The directed energy deposition additive manufacturing system of claim 1, wherein the mover moves the torch relative to the substrate in order to maintain the standoff distance based on the standoff distance measurement unit monitoring the geometric profile.
4. The directed energy deposition additive manufacturing system of claim 3, wherein the substrate is moved at least one of longitudinally or laterally relative to the torch.
5. The directed energy deposition additive manufacturing system of claim 1, wherein the mover moves the substrate relative to the torch in order to maintain the standoff distance based on the standoff distance measurement unit monitoring the geometric profile.

6. The directed energy deposition additive manufacturing system of claim 1, wherein the workpiece is a first workpiece, wherein the substrate is a second workpiece on which the first workpiece is additively manufactured.
7. The directed energy deposition additive manufacturing system of claim 1, wherein the substrate is not a workpiece.
8. The directed energy deposition additive manufacturing system of claim 1, wherein the geometric profile has a maximum height and a minimum height, wherein the standoff distance measurement unit monitors the geometric profile based on the maximum height and the minimum height.
9. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance is maintained based on a standoff set point accessed via the logic.
10. The directed energy deposition additive manufacturing system of claim 1, further comprising a user interface enabled to override the logic regarding control of at least one of
the standoff distance measurement unit, the substrate, the torch, the feed unit, or the mover.
11. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance is maintained based on a standoff distance for a temperature measurement.
12. The directed energy deposition additive manufacturing system of claim 1, wherein the logic runs on a controller, wherein the logic reads a control input from a deposition specification and an input from a user interface, wherein the deposition specification and the input are associated with the workpiece.
13. The directed energy deposition additive manufacturing system of claim 1, wherein the logic runs on a controller, wherein the logic controls the mover to enable

a deposition and a measurement scan, wherein the deposition and the measurement scan are associated with the workpiece.

14. The directed energy deposition additive manufacturing system of claim 1, wherein the logic runs on a controller, wherein the logic acquires a set of measurements from the standoff distance measurement unit, wherein the set of measurements is associated with the workpiece.

15. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance measurement unit scans at least one of the workpiece or the substrate, determines the standoff distance, and inputs the standoff distance to the logic on demand.

16. The directed energy deposition additive manufacturing system of claim 15, wherein the standoff distance measurement unit scans at least one of the workpiece or the substrate based on at least one of a time interval, a position, a resolution, or a filter.

17. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance measurement unit determines a feature of the workpiece, wherein the standoff distance is determined based on the feature.

18. The directed energy deposition additive manufacturing system of claim 17, wherein the feature is at least one of a shape of the workpiece, a gap in the workpiece, or an angle of the workpiece.

19. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance measurement unit is at least one of calibrated or programmed to eliminate at least one of an optical aberration or eliminate a stray light disturbance.

20. The directed energy deposition additive manufacturing system of claim 1, wherein the logic runs on a controller, wherein the logic performs a validation of a set of measurements, a sampling of the set of measurements based on the validation to

a preset spatial resolution, an availment of the set of measurements to a workpiece coordinate system based on a grid spacing.

21. The directed energy deposition additive manufacturing system of claim 1, wherein the logic runs on a controller, wherein the controller runs a feedback control logic to maintain the standoff distance.

22. The directed energy deposition additive manufacturing system of claim 1, wherein the logic is programmed to avoid at least one of a vibration or a jerky movement of a positioning unit.

23. The directed energy deposition additive manufacturing system of claim 1, wherein the feed unit is a wire feed unit having a feed speed, wherein the logic maintains the feed speed and in-turn computes a real-time DTCP position.

24. The directed energy deposition additive manufacturing system of claim 1, wherein the logic is programmed to control at least one of an inert gas flow, a welding current, a temperature, a loading of the workpiece, an unloading of the workpiece, a loading of a wire spool, or an unloading of the wire spool.

25. The directed energy deposition additive manufacturing system of claim 1, wherein the mover is at least one of a motor, an engine, an actuator, a mechanical linkage, a gear mechanism, a pulley mechanism, a hydraulic mechanism, or a pneumatic mechanism.

26. The directed energy deposition additive manufacturing system of claim 1, wherein the controller controls the mover to vertically move the torch in order to maintain the standoff distance based on how fast the substrate is moving.

27. The directed energy deposition additive manufacturing system of claim 1, wherein the controller controls the mover to vertically move the torch in order to maintain the standoff distance based on how fast the material is being melted via the plasma.

28. The directed energy deposition additive manufacturing system of claim 1, wherein the torch includes a central tip portion, wherein the controller controls the mover to vertically move the torch in order to maintain the standoff distance based on how fast the material is being fed such that a droplet resulting from the material being melted meets the workpiece before the drop is positioned underneath the central tip portion.

29. The directed energy deposition additive manufacturing system of claim 1, wherein the controller is programmed to request the mover to vertically move the torch smoothly in order to minimize a vibration of the torch while the torch is vertically moving.

30. The directed energy deposition additive manufacturing system of claim 1, wherein the controller is programmed to request the mover to vertically move the torch smoothly in order to minimize a sudden motion of the torch while the torch is moving along the vertical axis.

31. The directed energy deposition additive manufacturing system of claim 1, wherein the controller is programmed to request the mover to vertically move the torch in order to avoid a collision with an object engaging the substrate, wherein the object is other than the workpiece.

32. The directed energy deposition additive manufacturing system of claim 31, wherein the object is a clamp clamping the substrate.

33. The directed energy deposition additive manufacturing system of claim 1, wherein the controller is programmed to limit vertical movement of the torch on a per bead basis.

34. The directed energy deposition additive manufacturing system of claim 1, wherein the controller is programmed to limit vertical movement of the torch on a per workpiece basis.

35. The directed energy deposition additive manufacturing system of claim 1, wherein the controller is programmed to dynamically adjust vertical movement of the torch based on an error type.

36. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance measurement unit generates a plurality of readings, wherein the controller is programmed to receive the readings from the standoff distance measurement unit and to validate the readings before the controller requests the mover to vertically move the torch.

37. The directed energy deposition additive manufacturing system of claim 1, wherein the standoff distance measurement unit generates a plurality of readings, wherein the workpiece generates a reflection from the plasma, wherein the controller is programmed to apply at least one of a high dynamic range (HDR) or a pre-filtering technique to the readings in order to reduce at least one of the reflection or a stray light resulting from at least one of the workpiece or the plasma.

38. The directed energy deposition additive manufacturing system of claim 1, wherein the torch is a first torch, and further comprising a torch that preheats the substrate, wherein the second torch is positioned between the standoff distance measurement unit and the first torch.

39. The directed energy deposition additive manufacturing system of claim 1, wherein the controller controls the mover to vertically move the torch in order to maintain the standoff distance based on the substrate being at least one of longitudinally or laterally at least one of distorted, warped, or deformed.

40. The directed energy deposition additive manufacturing system of claim 1, wherein the controller controls the mover to vertically move the torch in order to maintain the standoff distance based on at least one of a feature of the workpiece, a joint of the workpiece, an intersection of the workpiece, an uneven height step, an uneven string surface, or at least one of a distortion, warping, or deformation of the substrate.

41. The directed energy deposition additive manufacturing system of claim 1, further comprising a sensor monitoring the mover, wherein the logic is coupled to the sensor, wherein the logic controls the mover to vertically move the torch in order to maintain the standoff distance based on the sensor.

42. A method for additive manufacturing, the method comprising:

outputting a material;

outputting a plasma via a torch;

melting the material via the plasma such that a workpiece is additively manufactured on a substrate, wherein the workpiece has a geometric profile, wherein the torch is vertically spaced apart from the workpiece such that a standoff distance is defined;

monitoring the geometric profile while the workpiece is being additively manufactured such that a mover can move at least one of the torch relative to the substrate or the substrate relative to the torch in order to maintain the standoff distance.