accuracy. The disclosed additive manufacturing system is uniquely configured to provide these improvements and/or to address other issues of the prior art.

Summary

[0004a] According to a first aspect of the present disclosure, there is provided an additive manufacturing system, comprising:

a support; and

a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge,

wherein:

the print head includes a module located at a trailing side of the discharging material relative to the normal travel direction, the module having a compactor configured to compact the material and to simultaneously expose the material to a cure energy at a tool center point;

the module is rotationally connected to a remainder of the print head; and

the cure energy is directed into the compactor from outside of the compactor.

[0004b] According to a second aspect of the present disclosure, there is provided an additive manufacturing system, comprising:

a support; and

a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge,

wherein:

the print head includes a module located at a trailing side of the discharging material relative to the normal travel direction and being configured to compact the material and to simultaneously expose the material to a cure energy at a tool center point; and

the module includes:

an outer cover configured to move against the material during compaction; and

a source configured to direct the cure energy from outside of the outer cover into the outer cover and radially outward through the outer cover.

[0004c] According to a third aspect of the present disclosure, there is provided an additive manufacturing system, comprising:

a support; and

a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge,

wherein the print head includes:

an outer cover located at a trailing side of the discharging material relative to the normal travel direction and being configured to move against the material; and

a source configured to direct cure energy from outside of the outer cover axially into the outer cover and radially outward through the outer cover.

[0005] There is also provided an additive manufacturing system. The additive manufacturing system may include a support, and a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge. The print head may include a module located at a trailing side of the discharging material relative to the normal travel direction and being configured to compact the material and expose the material to a cure energy at a tool center point.

[0006] There is also provided another additive manufacturing system. This additive manufacturing system may include a support, and a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge. The print head may include an outer cover located at a trailing side of the discharging material relative to the normal travel direction and being configured to roller over the material, and a source configured to direct the cure energy radially outward through the outer cover.

[0007] There is also provided a method of additively manufacturing a structure. The method may include discharging a matrix-wetted continuous reinforcement through an outlet of a print head, and pressing a module against the matrix-wetted continuous reinforcement after discharging to compress the matrix-wetted continuous reinforcement. The method may also include directing cure energy radially outward through the module to the matrix-wetted continuous reinforcement being compressed.

Brief Description of the Drawings

[0008] Fig. 1 is a diagrammatic illustration of an exemplary disclosed additive manufacturing system;

[0009] Figs. 2, 3, and 4, are isometric, diagrammatic, and cross-sectional illustrations, respectively, of exemplary disclosed portions of the system of Fig. 1; and

[0010] Fig. 5 and 6 are cross-sectional illustrations of other exemplary disclosed portions of the system of Fig. 1.

Claims

What is claimed is:

1. An additive manufacturing system, comprising:

a support; and

a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge,

wherein:

the print head includes a module located at a trailing side of the discharging material relative to the normal travel direction, the module having a compactor configured to compact the material and to simultaneously expose the material to a cure energy at a tool center point;

the module is rotationally connected to a remainder of the print head; and

the cure energy is directed into the compactor from outside of the compactor.

2. An additive manufacturing system, comprising:

a support; and

a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge,

wherein:

the print head includes a module located at a trailing side of the discharging material relative to the normal travel direction and being configured to compact the material and to simultaneously expose the material to a cure energy at a tool center point; and

the module includes:

an outer cover configured to move against the material during compaction; and

a source configured to direct the cure energy from outside of the outer cover into the outer cover and radially outward through the outer cover.

3. The additive manufacturing system of claim 2, wherein:

the module includes a shaft on which the outer cover is mounted; and

the source is configured to direct the cure energy from outside of the module axially into the shaft and then radially outward through the outer cover via a passage in the shaft.

4. The additive manufacturing system of claim 3, further including an optic mounted inside of the shaft and configured to redirect the cure energy directed axially into the shaft radially outward.

5. The additive manufacturing system of claim 3, further including a slotted distributor disposed between the shaft and the outer cover and configured to rotate about the shaft together with the outer cover.

6. The additive manufacturing system of claim 5, wherein:

the slotted distributor includes a plurality of axially oriented slots; and

the module further includes a spacer that is at least partially transparent to the cure energy disposed within each of the plurality of axially oriented slots.

7. The additive manufacturing system of claim 5, further including an inner cover disposed between the slotted distributor and the outer cover, wherein the inner cover is more compliant than the outer cover.

8. The additive manufacturing system of claim 7, wherein each of the inner and outer covers is at least partially transparent to the cure energy.

9. The additive manufacturing system of claim 1, further including at least one divider aligned with an axis of the module and configured to focus the cure energy to an arcuate segment of the module.

10. The additive manufacturing system of claim 1, further including at least one divider extending radially outward through the module and configured to focus the cure energy in an axial direction of the module.

11. The additive manufacturing system of claim 1, wherein the module includes:

an outer cover configured to roll over the material during compaction;

an arm extending radially outward past the outer cover;

a bar connected to a distal end of the arm and extending in an axial direction of the module; and

an actuator connected to the arm and configured to selectively pull the bar radially inward against the outer cover.

12. The additive manufacturing system of claim 11, further including a cutting device operatively connected to the bar.

13. An additive manufacturing system, comprising:

a support; and

a print head configured to discharge a material and being operatively connected to and moveable by the support in a normal travel direction during material discharge,

wherein the print head includes:

an outer cover located at a trailing side of the discharging material relative to the normal travel direction and being configured to move against the material; and

a source configured to direct cure energy from outside of the outer cover axially into the outer cover and radially outward through the outer cover.

14. The additive manufacturing system of claim 13, further including a shaft on which the outer cover is mounted, wherein the source is configured to direct the cure energy axially into the shaft and then radially outward through the outer cover via a passage in the shaft.

15. The additive manufacturing system of claim 14, further including an optic mounted inside of the shaft and configured to redirect the cure energy directed axially into the shaft radially outward.

16. The additive manufacturing system of claim 15, further including a slotted distributor disposed between the shaft and the outer cover and configure to rotate with the outer cover.

17. The additive manufacturing system of claim 13, further including at least one divider configured to focus the cure energy to an arcuate segment.

18. The additive manufacturing system of claim 1, wherein the tool center point is a nip point of a compactor.

19. The additive manufacturing system of claim 7, wherein the outer cover has a hardness that is 5-10% greater than a hardness of the inner cover.