things, are adjusted to perform location specific processing of a workpiece.

[0006] According to a first aspect, an apparatus for processing a workpiece with a beam is described. The apparatus includes a vacuum chamber having a beam-line for forming a particle beam and treating a workpiece with the particle beam, and a scanner for translating the workpiece through the particle beam. The apparatus further includes a scanner control circuit coupled to the scanner, and configured to control a scan property of the scanner, a beam control circuit coupled to at least one beam-line component, and configured to control the beam flux of the particle beam according to a duty cycle for switching between at least two different states during processing and a control system including a controller coupled with the scanner control circuit; and beam control circuit, the control system configured for processing parametric data associated with an attribute of at least a portion of the workpiece and for forming a correction map for the workpiece, the controller configured to determine at least one limitation in controlling a scan property of the scanner when applying the correction map and, in response to the determined limitation, to controllably vary the duty cycle of the particle beam through the beam control circuit.

[0007] According to a second aspect, a method for processing a workpiece with a particle beam is described. The method includes: mounting a workpiece on a scanner in a vacuum chamber for forming a particle beam and treating the workpiece with the particle beam; generating a particle beam in the vacuum chamber; scanning the workpiece through the particle beam and controlling at least one scan property of the scanner; controlling the beam flux of the particle beam according to a duty cycle for switching between at least two different states during processing; processing parametric data associated with an attribute of at least a portion of the workpiece and forming a correction map for the workpiece; controllably adjusting at least one scan property of the scanner in applying the correction map for treating the workpiece; determining at least one limitation in controlling the scan property of the scanner when applying the correction map and, in response to the determined limitation, controllably varying the duty cycle of the particle beam through the beam control circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

[0008] FIG. 1 provides an illustration of a beam processing system according to an embodiment;

[0009] FIGs. 2A and 2B illustrate methods of processing a workpiece according to an embodiment;

[0010] FIGs. 3A and 3B illustrate methods of processing a workpiece according to another embodiment;

[0011] FIG. 4 provides an illustration of a corrective processing system according to an embodiment;

[0012] FIG. 5 is a flow chart illustrating a method for processing a workpiece according to another embodiment; and

CLAIMS

CLAIMS

1. An apparatus for processing a workpiece with a beam, comprising:

a vacuum chamber having a beam-line for forming a particle beam and treating a workpiece with the particle beam;

a scanner for translating the workpiece through the particle beam;

a scanner control circuit coupled to the scanner, and configured to control a scan property of the scanner;

a beam control circuit coupled to at least one beam-line component, and configured to control the beam flux of the particle beam according to a duty cycle for switching between at least two different states during processing; and

a control system including a controller coupled with the scanner control circuit and beam control circuit, the control system configured for processing parametric data associated with an attribute of at least a portion of the workpiece and for forming a correction map for the workpiece, the controller configured to determine at least one limitation in controlling a scan property of the scanner when applying the correction map and, in response to the determined limitation, to controllably vary the duty cycle of the particle beam through the beam control circuit.

2. The apparatus of claim 1, wherein the particle beam includes a charged particle beam or an un-charged particle beam.

3. The apparatus of claim 2, where the particle beam includes a neutral beam, a gas cluster beam, a gas cluster ion beam, an ion beam, an electron beam, or combinations thereof.

4. The apparatus of claim 1, wherein the vacuum chamber includes plural beam-lines for forming multiple particle beams.

5. The apparatus of claim 1, wherein the scan property includes a scan velocity, a scan path, a scan acceleration, a scan location, or any combination of two or more thereof.

6. The apparatus of claim 1, wherein the beam control circuit toggles the particle beam between a substantially on-state and a substantially off-state, the beam flux for the on-state being appreciably greater than the off-state.

7. The apparatus of claim 1, wherein the beam control circuit is coupled to an ionizer, and wherein the ionizer is controlled to toggle the particle beam between a charged state and an uncharged state.

8. The apparatus of claim 7, wherein the beam control circuit controls the electron flux emanating from the ionizer and intersecting with the particle beam.

9. The apparatus of claim 1, wherein the beam control circuit is coupled to an acceleration electrode, and wherein the accelerator electrode is controlled to toggle the particle beam between at least two different accelerated states.

10. The apparatus of claim 1, wherein the beam control circuit is coupled to a particle beam deflection electrode, and wherein the beam deflection electrode is controlled to toggle the particle beam between at least two deflection states including an intersecting state and a non-intersecting state with the workpiece.

11. The apparatus of claim 1, wherein the beam control circuit is coupled to a beam gate, and wherein the beam gate is controlled to toggle the particle beam between a beam gate obstructed state and a beam gate unobstructed state.

12. The apparatus of claim 1, wherein the at least two different states include an on-state and an off-state.

13. The apparatus of claim 1, wherein the controller is configured to determine that the scanner control circuit reaches a maximum scan velocity, and wherein the beam control circuit varies the duty cycle by decreasing the duty cycle for switching the beam flux between at least two different states in response to reaching the maximum scan velocity.

14. The apparatus of claim 1, wherein the controller is configured to determine that the scanner control circuit reaches a maximum scan acceleration, and wherein the beam control circuit varies the duty cycle by decreasing the duty cycle for switching the beam flux between at least two different states in response to reaching the maximum scan acceleration.

15. A method for processing a workpiece with a particle beam, comprising:

mounting a workpiece on a scanner in a vacuum chamber for forming a particle beam and treating the workpiece with the particle beam;

generating a particle beam in the vacuum chamber;

scanning the workpiece through the particle beam and controlling at least one scan property of the scanner;

controlling the beam flux of the particle beam according to a duty cycle for switching between at least two different states during processing;

processing parametric data associated with an attribute of at least a portion of the workpiece and forming a correction map for the workpiece; controllably adjusting at least one scan property of the scanner in applying the correction map for treating the workpiece; and

determining at least one limitation in controlling the scan property of the scanner when applying the correction map and, in response to the determined limitation, controllably varying the duty cycle of the particle beam through the beam control circuit.

16. The method of claim 15, wherein the particle beam includes a charged particle beam or an uncharged particle beam.

17. The method of claim 15, where the particle beam includes a neutral beam, a gas cluster beam, a gas cluster ion beam, an ion beam, an electron beam, or combinations thereof.

18. The method of claim 15, wherein determining at least one limitation in controlling a scan property of the scanner includes determining when a maximum scan velocity is reached.

19. The method of claim 16, wherein determining at least one limitation in controlling a scan property of the scanner includes determining when a maximum scan acceleration is reached.