Claims

1. A multi-beam scanning electron microscopy apparatus comprising: a multi-beam scanning electron microscopy sub-system comprising: a multi-beam electron source configured to form a plurality of electron beams; a sample stage configured to secure a sample; an electron-optical assembly including a set of electron-optical elements configured to direct at least a portion of the plurality of electron beams onto a portion of the sample; and a detector assembly configured to simultaneously acquire a plurality of images of the surface of the sample, each image associated with an electron beam of the plurality of electron beams; a controller including one or more processors configured to execute a set of program instructions stored in memory for causing the one or more processors to: receive the plurality of images from the detector assembly; disregard one or more images lacking sufficient structural features to determine at least one of focus or astigmatism of the disregarded one or more images; identify at least one of a best focus image or a best astigmatism image of a plurality of remaining images by analyzing one or more image quality parameters of at least some of the plurality of the remaining images; and direct the multi-beam source to adjust at least one of focus or astigmatism of one or more electron beams based on at least one of focus or astigmatism of an electron beam corresponding with at least one of the identified best focus image or the identified best astigmatism image.

2. The apparatus of claim 1, wherein two or more of the images acquired by the detector assembly have different foci.

3. The apparatus of claim 2, wherein the different foci are established unintentionally by one or more components of the multi-beam scanning electron microscopy sub-system.

4. The apparatus of claim 2, wherein the different foci are established intentionally by one or more components of the multi-beam scanning electron microscopy sub-system.

5. The apparatus of claim 1, wherein two or more of the images acquired by the detector assembly have different amounts of astigmatism.

6. The apparatus of claim 5, wherein the different amounts of astigmatism are established unintentionally by one or more components of the multi-beam scanning electron microscopy sub-system.

7. The apparatus of claim 5, wherein the different amounts of astigmatism are established intentionally by one or more components of the multi-beam scanning electron microscopy sub-system.

8. The apparatus of claim 1, wherein the controller is configured to identify a best focus image of the plurality of images by analyzing image sharpness of at least some of the images of the plurality of the images.

9. The apparatus of claim 1, wherein the controller is configured to: prior to identifying best focus of the plurality of images, average two or more images.

10. The apparatus of claim 9, wherein the controller is configured to: prior to identifying best focus of the plurality of images, average two or more repeat images.

11. The apparatus of claim 1, wherein the controller is configured to: prior to identifying best astigmatism of the plurality of images, average two or more images.

12. The apparatus of claim 11, wherein the controller is configured to: prior to identifying best astigmatism of the plurality of images, average two or more repeat images.

13. The apparatus of claim 1, wherein the multi-beam electron source comprises: an electron gun configured to emit an illumination beam; and a multi-lens array assembly configured to split the illumination beam into the plurality of electron beams.

14. The apparatus of claim 1, wherein the set of electron-optical elements comprise: at least one of a condenser lens or objective lens.

15. The apparatus of claim 1, wherein the detector assembly comprises: a detector array.

16. The apparatus of claim 1, wherein the detector assembly comprises: one or more secondary electron detectors.

17. The apparatus of claim 1, wherein the detector assembly comprises: one or more backscattered electron detectors.

18. A multi-beam scanning electron microscopy apparatus comprising: a multi-beam scanning electron microscopy sub-system comprising: a multi-beam electron beam source including an electron gun configured to generate an illumination beam and a multi-lens array assembly configured to split the illumination beam into a plurality of electron beams, wherein the multi-lens array assembly is configured for adjusting focus of one or more lenses of the lens array assembly; a sample stage configured to secure a sample; an electron-optical assembly a set of electron-optical elements configured to direct at least a portion of the plurality of electron beams onto a portion of the sample; and a detector assembly configured to simultaneously acquire a plurality of images of the surface of the sample, each image associated with an electron beam of the plurality of electron beams; a controller including one or more processors configured to execute a set of program instructions stored in memory for causing the one or more processors to: direct the multi-beam scanning electron microscopy sub-system to simultaneously acquire a first plurality of images in an under-focused condition, a second plurality of images in an over-focused condition, and a current plurality of images at a current focus; receive the first plurality of images acquired in the under-focused condition, the second plurality of images acquired in the over-focused condition, and the current plurality of images from the detector assembly; identify focus drift in one or more of the current plurality of images by comparing one or more of the first plurality of images and one or more of the second plurality of images to of the one or more of the current plurality of images acquired at the current focus; and direct the multi-lens array to adjust a focus of one or more electron beams to compensate for the identified focus drift.

19. A multi-beam scanning electron microscopy apparatus comprising: a multi-beam scanning electron microscopy sub-system comprising: a plurality of multi-beam electron sources configured to form a plurality of electron beams; a sample stage configured to secure a sample; an electron-optical assembly including a set of electron-optical elements configured to direct at least a portion of the plurality of electron beams onto a portion of the sample; and a detector assembly configured to simultaneously acquire a plurality of images of the surface of the sample, each image associated with an electron beam of the plurality of electron beams; a controller including one or more processors configured to execute a set of program instructions stored in memory for causing the one or more processors to: receive the plurality of images from the detector assembly; disregard one or more images lacking sufficient structural features to determine at least one of focus or astigmatism of the disregarded one or more images; identify at least one of a best focus image or a best astigmatism image of a plurality of remaining images by analyzing one or more image quality parameters of at least some of the plurality of remaining images; and direct one or more electron-optical elements to adjust at least one of focus or astigmatism of one or more electron beams based on at least one of focus or astigmatism of an electron beam corresponding with at least one of the identified best focus image or the identified best astigmatism image.

20. A multi-beam scanning electron apparatus comprising: a multi-beam microscopy sub-system to perform a line scan of a plurality of electron beams comprising: a multi-beam electron source configured to form the plurality of electron beams; a sample stage configured to secure a sample; an electron-optical assembly including a set of electron-optical elements configured to direct at least a portion of the plurality of electron beams onto a portion of the sample; and a detector assembly configured to simultaneously acquire a plurality of images of the surface of the sample, each image associated with an electron beam of the plurality of electron beams; a controller including one or more processors configured to execute a set of program instructions stored in memory for causing the one or more processors to: receive a plurality of line scans from the detector assembly; disregard one or more line scans lacking sufficient structural features to determine at least one of focus line scan or astigmatism line scan of the disregarded one or more line scans; identify at least one of a best focus line scan or a best astigmatism line scan of a plurality of remaining line scans by analyzing one or more line scan parameters of at least some of the plurality of remaining line scans; and direct the multi-lens source to adjust at least one of focus or astigmatism of one or more electron beams based on at least one of focus or astigmatism of an electron beam corresponding with at least one of the identified best focus line scan or the identified best astigmatism line scan.