CLAIMS

What is claimed is:

1. An apparatus comprising:

an electromagnet arranged to provide a large-scale magnetic field in a region; and

an array of multiple electron beam columns formed in the region using an array of bores through magnetic material.

2. The apparatus of claim 1, wherein the region is between at least two magnetic pole pieces of the electromagnet.

3. The apparatus of claim 2, wherein the array of bores goes through a flux by-pass plate between said at least two magnetic pole pieces.

4. The apparatus of claim 1, further comprising:

first and second pole pieces of the electromagnet, wherein the array of bores goes through the first pole piece.

5. The apparatus of claim 1 further comprising:

a movable stage configured to hold a wafer, Mask, EUV mask, or other flat substrates with substantially limited thickness beneath the array of multiple electron beam columns.

6. The apparatus of claim 1, wherein an electron beam column of the multiple electron beam columns comprises multiple electrodes formed within a bore.

7. The apparatus of claim 6, wherein the electron beam column comprises an electron source including an emitter and an extraction aperture having a voltage applied thereto so as to extract electrons from the emitter.

8. The apparatus of claim 6, wherein the electron beam column further comprises a resistive liner between the bore and the multiple electrodes.

9. The apparatus of claim 6, wherein the electron beam column further comprises:

a column aperture separating an upper portion of the column from a lower portion of the column,

wherein the multiple electrodes include a gun lens electrode and a grounded electrode in the upper portion of the column,

wherein the gun lens electrode is configured to condense electrons into an electron beam, and

wherein the grounded electrode is configured to center the electron beam so that the electron beam travels through the column aperture.

10. The apparatus of claim 9, wherein the multiple electrodes further include at least one auxiliary electrode and an extractor electrode in the lower portion of the column, further wherein the at least one auxiliary electrode is configured to provide a first deflection of the electron beam, and the extractor electrode is configured to provide a second deflection of the electron beam.

11. The apparatus of claim 9, wherein the electron beam column further comprises a detector which is configured to detect secondary electrons and configured to define the beam through limiting divergent beam traces.

12. The apparatus of claim 9, wherein the electron beam column further comprises a blanking plate which is configured to be actuated to block the electron beam from entering the lower portion of the column

13. A method of generating an array of electron beams, the method comprising:

generating a large-scale magnetic field in a region using at least two magnetic poles; and

generating an array of electron beams using an array of columns formed using bores through a magnetic material positioned in the region.

14. The method of claim 13, wherein an electron beam of the array of electron beams is generated using multiple electrodes formed within a bore through the magnetic material.

15. The method of claim 12 further comprising:

holding a manufactured substrate beneath the array of columns on the movable stage.

16. The method of claim 15 further comprising:

detecting secondary electrons emitted from the semiconductor wafer using detectors within the columns of the array of columns.

17. The method of claim 15 further comprising:

selectively blanking electron beams of the array of electron beams so as to write a pattern onto a layer of the manufactured substrate.

17. An array of electron beam columns comprising:

a magnetic material positioned in a large-scale magnetic field;

an array of bores through the magnetic material, wherein each bore in the array of bores has a first end and a second end;

an array of electron sources, wherein each source in the array of electron sources is configured to emit electrons into the first end of a corresponding bore in the array of bores; and

multiple electrodes arranged within each bore of the array of bores.

18. The array of electron beam columns of claim 17, wherein a size of an opening at the first end of each bore is different from a size of an opening at the second end.

19. The array of electron beam columns of claim 17, wherein the magnetic material comprises a flux by-pass plate between two poles that form the large-scale magnetic field.

20. The array of electron beam columns of claim 17, wherein the magnetic material comprises one of two poles that form the large-scale magnetic field.

CLAIMS

1. An apparatus comprising:

an electromagnet arranged to provide a large-scale magnetic field in a region; and

an array of multiple electron beam columns formed in the region using an array of bores through magnetic material.

2. The apparatus of claim **1**, wherein the region is between at least two magnetic pole pieces of the electromagnet.

3. The apparatus of claim **2**, wherein the array of bores goes through a flux by-pass plate between said at least two magnetic pole pieces.

4. The apparatus of claim **1**, further comprising:

first and second pole pieces of the electromagnet, wherein the array of bores goes through the first pole piece.

5. The apparatus of claim **1** further comprising:

a movable stage configured to hold a wafer, Mask, EUV mask, or other flat substrates with substantially limited thickness beneath the array of multiple electron beam columns.

6. The apparatus of claim **1**, wherein an electron beam column of the multiple electron beam columns comprises multiple electrodes formed within a bore.

7. The apparatus of claim **6**, wherein the electron beam column comprises an electron source including an emitter and an extraction aperture having a voltage applied thereto so as to extract electrons from the emitter.

8. The apparatus of claim **6**, wherein the electron beam column further comprises a resistive liner between the bore and the multiple electrodes.

9. The apparatus of claim **6**, wherein the electron beam column further comprises:

a column aperture separating an upper portion of the column from a lower portion of the column,

wherein the multiple electrodes include a gun lens electrode and a grounded electrode in the upper portion of the column,

wherein the gun lens electrode is configured to condense electrons into an electron beam, and

wherein the grounded electrode is configured to center the electron beam so that the electron beam travels through the column aperture.

10. The apparatus of claim **9**, wherein the multiple electrodes further include at least one auxiliary electrode and an extractor electrode in the lower portion of the column, further wherein the at least one auxiliary electrode is configured to provide a first deflection of the electron beam, and the extractor electrode is configured to provide a second deflection of the electron beam.

11. The apparatus of claim **9**, wherein the electron beam column further comprises a detector which is configured to detect secondary electrons and configured to define the beam through limiting divergent beam traces.

12. The apparatus of claim **9**, wherein the electron beam column further comprises a blanking plate which is configured to be actuated to block the electron beam from entering the lower portion of the column.

13. A method of generating an array of electron beams, the method comprising:

generating a large-scale magnetic field in a region using at least two magnetic poles; and

generating an array of electron beams using an array of columns formed using bores through a magnetic material positioned in the region.

14. The method of claim **13**, wherein an electron beam of the array of electron beams is generated using multiple electrodes formed within a bore through the magnetic material.

15. The method of claim **13** further comprising:

holding a manufactured substrate beneath the array of columns on a movable stage.

16. The method of claim **15** further comprising:

detecting secondary electrons emitted from the manufactured substrate using detectors within the columns of the array of columns.

17. The method of claim **15** further comprising:

selectively blanking electron beams of the array of electron beams so as to write a pattern onto a layer of the manufactured substrate.

18. An array of electron beam columns comprising:

a magnetic material positioned in a large-scale magnetic field;

an array of bores through the magnetic material, wherein each bore in the array of bores has a first end and a second end;

an array of electron sources, wherein each source in the array of electron sources is configured to emit electrons into the first end of a corresponding bore in the array of bores; and

multiple electrodes arranged within each bore of the array of bores.

19. The array of electron beam columns of claim **18**, wherein a size of an opening at the first end of each bore is different from a size of an opening at the second end.

20. The array of electron beam columns of claim **18**, wherein the magnetic material comprises a flux by-pass plate between two poles that form the large-scale magnetic field.

21. The array of electron beam columns of claim **18**, wherein the magnetic material comprises one of two poles that form the large-scale magnetic field.