Claims

1. A chalcogenide material comprising 1-5 atomic percent (at%) of silicon, 10-20 at% of germanium, 25-35 at% of arsenic, 40-50 at% of selenium, and 1-10 at% of tellurium.

2. The chalcogenide material of claim 1, wherein content of germanium is 15-20 at%.

3. The chalcogenide material of claim 1, content of arsenic is 25-30 at%.

4. The chalcogenide material of claim 1, wherein content of selenium is 42-47 at%.

5. The chalcogenide material of claim 1, wherein content of tellurium is 2-8 at%.

6. The chalcogenide material of claim 1, wherein a sum of content of silicon and content of germanium is 20 at% or more.

7. An electronic device comprising:

a switching element including a chalcogenide material, the chalcogenide material including 1-5 atomic percent (at%) of silicon, 10-20 at% of germanium, 25-35 at% of arsenic, 40-50 at% of selenium, and 1-10 at% of tellurium;

a first electrode electrically coupled to the switching element; and

a second electrode electrically coupled to the switching element.

8. The electronic device of claim 7, wherein content of germanium is 15-20 at%.

9. The electronic device of claim 7, wherein content of arsenic is 25-30 at%.

10. The electronic device of claim 7, wherein content of selenium is 42-47 at%.

11. The electronic device of claim 7, wherein content of tellurium is 2-8 at%.

12. The electronic device of claim 7, wherein a sum of content of silicon and content of germanium is 20 at% or more.

13. An electronic device comprising a semiconductor memory device, the semiconductor memory device including a first memory cell including a first switching element,

wherein the first switching element includes a chalcogenide material including 1-5 atomic percent (at%) of silicon, 10-20 at% of germanium, 25-35 at% of arsenic, 40-50 at% of selenium, and 1-10 at% of tellurium.

14. The electronic device of claim 13, wherein the semiconductor memory device further includes:

a second memory cell including a second switching element, the second switching element having a chalcogenide material including 1-10 atomic percent (at%) of silicon, 10-20 at% of germanium, 25-35 at% of arsenic, 40-50 at% of selenium, and 1-10 at% of tellurium, and

wherein the first memory cell and the second memory cell further include a first memory layer and a second memory layer, respectively, each of the first and second memory layers switching between different resistance states according to a voltage or a current applied thereto.

15. The electronic device of claim 14, wherein the first switching element and the second switching element control access to the first memory layer and the second memory layer, respectively.

16. The electronic device of claim 13, wherein the semiconductor memory device includes a plurality of memory cells including the first memory cell,

wherein the semiconductor memory device further includes:

a plurality of first lines disposed between a substrate and the plurality of memory cells, each of the plurality of first lines extending in a first direction; and

a plurality of second lines disposed over the plurality of memory cells, each of the plurality of second lines extending in a second direction that crosses the first direction, and

wherein the plurality of memory cells are disposed at respective intersections of the first lines and the second lines.

17. The electronic device of claim 13, wherein the semiconductor memory device further includes a capping layer disposed over at least side surfaces of the first memory cell.

18. The electronic device of claim 13, wherein a sum of content of silicon and content of germanium is 20 at% or more.

19. The electronic device of claim 14, wherein the chalcogenide material of the second switching element includes 1-5 atomic percent (at%) of silicon, 10-20 at% of germanium, 25-35 at% of arsenic, 40-50 at% of selenium, and 1-10 at% of tellurium.