

CLAIMS

1. A phase change memory device, comprising:
a phase change memory material within an electrically insulating wall;
a first heater terminal in the electrically insulating wall; and
two read terminals in the electrically insulating wall.
2. The phase change memory device of claim 1, further comprising a second heater terminal in the electrically insulating wall, wherein the second heater terminal is separated from the first heater terminal by a thickness of the phase change memory material.
3. The phase change memory device of claim 2, wherein the second heater terminal is opposite the first heater terminal.
4. The phase change memory device of claim 1, wherein at least a portion of the phase change memory material is in a crystalline phase.
5. The phase change memory device of claim 4, wherein at least a portion of the phase change memory material is in an amorphous phase.
6. The phase change memory device of claim 5, wherein the amorphous phase of the phase change material is in the shape of a hemisphere adjoining the first heater terminal.
7. The phase change memory device of claim 5, wherein the phase change material has dimensions in a range of about 50 nm (length) X 50 nm (width) X 50 nm (height) to about 250 nm (length) X 250 nm (width) X 100 nm (height).
8. The phase change memory device of claim 5, wherein the amorphous phase of the phase change material includes a first hemisphere adjoining the first heater terminal and a second hemisphere adjoining a second heater terminal.
9. The phase change memory device of claim 8, wherein the distance between the first hemisphere and the second hemisphere determines the state of the phase change memory device.
10. A phase change memory device, comprising:
a phase change memory material within an electrically insulating wall;

two heater terminals in the electrically insulating wall, wherein the heater terminals are on opposite sides of the phase change memory material; and

two read terminals in the electrically insulating wall, wherein the read terminals are on opposite sides of the two heater terminals.

11. The phase change memory device of claim 10, wherein the two read terminals are located along the same side of the electrically insulating wall.

12. The phase change memory device of claim 10, wherein the two heater terminals are separated by a height of the phase change memory material within an electrically insulating wall in a range of about 50 nm to about 100 nm.

13. The phase change memory device of claim 10, wherein the two heater terminals are made of a material selected from the group consisting of titanium nitride (TiN), tantalum nitride (TaN), tungsten nitride (WN), titanium silicide (TiSi), cobalt silicide (CoSi), nickel silicide (NiSi), titanium carbide (TiC), tantalum carbide (TaC), tungsten (W), cobalt (Co), platinum (Pt), palladium (Pd), or tantalum (Ta), and combinations thereof.

14. The phase change memory device of claim 13, wherein the phase change memory material is $\text{Ge}_2\text{Sb}_2\text{Te}_5$ (GST).

15. A method of forming a phase change memory device, comprising:
forming a base plate layer on a substrate;
forming a first read terminal and a first heater terminal in the base plate layer;
forming a patterned phase change material having a first phase on the base plate layer;
forming an encapsulation layer on the patterned phase change material; and
forming a second read terminal in the encapsulation layer, wherein the second read terminal is in electrical contact with the patterned phase change material.

16. The method of claim 15, further comprising forming a second heater terminal in the encapsulation layer.

17. The method of claim 16, wherein the phase change memory material is $\text{Ge}_2\text{Sb}_2\text{Te}_5$ (GST).

18. The method of claim 17, wherein at least a portion of the phase change memory material is in a crystalline phase.

19. The method of claim 18, wherein the two heater terminals are separated by a height of the phase change memory material within an electrically insulating wall in a range of about 50 nm to about 100 nm.

20. The method of claim 19, wherein the first and second heater terminals are made of a material selected from the group consisting of titanium nitride (TiN), tantalum nitride (TaN), tungsten nitride (WN), titanium silicide (TiSi), cobalt silicide (CoSi), nickel silicide (NiSi), titanium carbide (TiC), tantalum carbide (TaC), tungsten (W), cobalt (Co), platinum (Pt), palladium (Pd), or tantalum (Ta), and combinations thereof.