CLAIMS

1. A heatsink assembly, comprising:

a substrate having an active circuitry, said substrate comprises:

at least one cavity located adjacent to at least one heat producing element of said active circuitry;

at least one vessel sealably coupled to said substrate in fluid communication with said at least one cavity; and

a phase change material (PCM) contained inside said at least one vessel;

wherein said at least one vessel and at least one cavity are configured to facilitate migration of said PCM from said at least one vessel into said at least one cavity for absorbing heat produced by said at least one heat producing element of said active circuitry.

2. The heatsink assembly of claim 1 wherein the at least one vessel and the at least one cavity are configured to circulate the PCM therebetween, to thereby transfer the heat absorbed by the PCM to the at least one vessel.

3. The heatsink assembly of claim 1, further comprising a porous medium contained inside the at least one vessel and configured to facilitate migration of said PCM therethrough towards the at least one cavity in the substrate.

4. The heatsink assembly of claim 1, further comprising a porous medium contained inside the at least one cavity and configured to facilitate migration of the PCM inside the substrate towards the at least one heat producing element.

5. The heatsink assembly of claim 3 wherein at least one of the at least one vessel or the porous medium is configured to condense the heated PCM.

6. The heatsink assembly of claim 3 wherein the porous medium defines pore sizes in a range of 100 nanometer to 70,000 nanometer.

7. The heatsink assembly of claim 3 wherein the porous medium comprises a sintered material.

8. The heatsink assembly of claim 3 wherein the porous medium comprises metal material, ceramic material, or a combination thereof.

9. The heatsink assembly of claim 1, further comprising a carrier board to which the substrate is attached, said carrier board comprising at least one via configured to communicate between the at least one vessel and the at least one cavity and facilitate migration of the PCM therethrough from said at least one vessel into said at least one cavity.

10. The heatsink assembly of claim 9, further comprising a plurality of substrates, each having a respective active circuitry and at least one cavity located adjacent to at least one heat producing element of said respective active circuitry, said plurality of substrates attached to the carrier board, and said carrier board comprising a respective at least one via configured to communicate between the at least one vessel and the at least one cavity of a respective substrate of said plurality of substrates.

11. The heatsink assembly of claim 10, further comprising a plurality of the at least vessel, each of which contains PCM and being sealably coupled to at least one of the plurality of substrates in fluid communication with at least one cavity thereof through at least one of the vias of the carrier board.

12. The heatsink assembly of claim 11, further comprising a respective vessel for each one of the plurality of substrates.

13. The heatsink assembly of claim 9 wherein the at least one via is configured to facilitate capillary motion of the PCM therethrough.

14. The heatsink assembly of claim 9 wherein a diameter of the at least one via is in a range of 10 micrometer to 100 micrometer.

15. The heatsink assembly of claim 9 wherein the carrier board comprises at least one cavity configured to receive the PCM from the at least one vessel and facilitate migration of the PCM therethrough to the at least one cavity of a substrate through the at least one via of the carrier board.

16. The heatsink assembly of claim 15 wherein the at least one cavity of the carrier board comprises a porous medium configured to facilitate the PCM migration therethrough.

17. The heatsink assembly of claim 16 wherein the porous medium define pore sizes in a range of 100 nanometer to 70,000 nanometer.

18. The heatsink assembly of claim 16 wherein the porous medium comprises a sintered material.

19. The heatsink assembly of claim 16 wherein the porous medium comprises metal or ceramic materials, or a combination thereof.

20. The heatsink assembly of claim 9 wherein the carrier board comprises at least one coating layer applied over a surface area thereof, and wherein the at least one via passes through said at least one coating layer.

21. The heatsink assembly of claim 20 wherein the at least one coating layer is electrically coupled to the active circuitry.

22. The heatsink assembly of claim 20 wherein the at least one coating layer is configured to disperse heat removed from the substrate by the PCM.

23. The heatsink assembly of claim 20 wherein the at least one vessel is sealably attached over the at least one coating layer of the carrier board.

24. The heatsink assembly of claim 1 wherein the PCM migration is achieved by capillary action.

25. The heatsink assembly of claim 1 wherein the at least one vessel comprises one or more materials having good thermal conductivity.

26. The heatsink assembly of claim 25 wherein the at least one vessel comprises a material having thermal conductivity greater than 100 w/(m·K).

27. The heatsink assembly of claim 25 wherein the vessel comprises at least one of Copper, Gold, Aluminum, or Silver

28. The heatsink assembly of claim 1 wherein the at least one cavity of the substrate exhibits a depth in a range of 55% to 85% of a thickness of said substrate.

29. The heatsink assembly of claim 1 wherein a distance of an edge of the at least one cavity from the at least one heat producing element of the active circuitry is in a range of 20 micrometer to 50 micrometer.

30. The heatsink assembly of claim 1 wherein the at least one cavity in said substrate exhibits a width in a range of 5 micrometer to 70 micrometer.

31. The heatsink assembly of claim 1 wherein the substrate is made from a semiconducting material.

32. The heatsink assembly of claim 31 wherein the substrate is made of Gallium-Arsenide.

33. The heatsink assembly of claim 31 wherein the substrate is made of Silicon.

34. The heatsink assembly of claim 1 wherein the PCM comprises water.