Embedded Vapor Chamber in Microelectronics Devices

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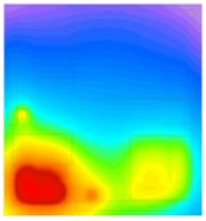

Figure 1: Hotspot on a chip [4]

In the recent years, hotspots resulting from chip miniaturization and densification and their dissipation have become one of the most limiting factor in the conception of more and more performant chips [1].This thermal management issue is particularly critical for mobile devices like smartphones or tablets in which the space available for heat extraction systems is extremely limited. Different studies have so been made to develop chip cooling systems as compact and efficient as possible [2], [3]. The goal of this project is to propose a performant chip cooling and thermal homogenization solution, more efficient than current passive heat spreaders and compact enough to be compatible with an integration in mobile devices. The presented solution consists in a so-called "vapor chamber", a passive phase change cooling system directly integrated in the backside of the silicon substrate of a chip. The device is detailed in *Figure 2.a*: it is composed of a sealed silicon cavity in which a working fluid transports the heat thanks to evaporation and condensation cycles, as illustrated in *Figure 2.b*. The inside of the cavity is composed of a wick structure and a vapor core allowing fluid circulation in liquid and vapor phases respectively.

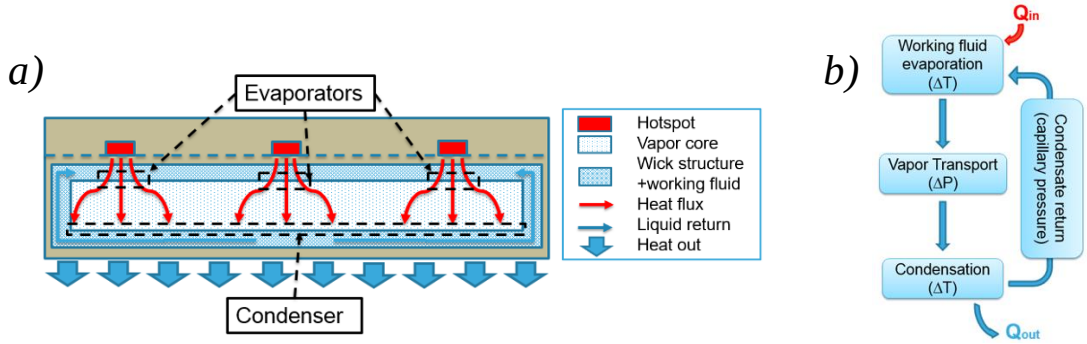

Figure 2: Composition of the different parts of a vapour chamber system (a) and the associated working fluid cycle (b).

This system is independent and self-adaptive. It runs until a homogeneous temperature is reached or until it is cooled below the fluid vaporization temperature. The vapor chamber dimensions and structures are determined by simulation and its design is thought to be compatible with packaging and microelectronics processes. The models of the device made so far have been used to select different possible wick structures and vapor chamber dimensions, which should now be experimentally tested and characterized.

References

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