Architectured structures optimization for the capture, storage and release of thermal energy

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Abstract: The problematic of heat storage is important in the present context. One of the solutions is to use phase change materials (PCM). Nevertheless their thermal properties are poor and a conductive substrate must absolutely be used in order to maximise the yield of these systems.
The purposes of this PhD are the physics phenomena implementation understanding and characterization, and the optimization of architectured structures for heat storage systems. A dual approach was adopted both experimental and numerical on simple PCM reception structures (fins) and on more complex ones (open foams). We analyzed influences of geometrical parameters (system length and porosity, thickness and space between fins, cell foam size) from reception structure, its constituent material and its orientation. Experimental results support well with numerical simulations. This permits to pursue a more systematical study about analyzed parameters, and notably to identify in which cases natural convection has to be taken into account. Finally, from these results, we developed a tool which permits to optimize architectured structures for a defined bill of specifications.

Key words: Architectured structures, Heat storage, Natural convection, PCM