Development of a technical method for performing cell culture on a Bio-MEMS

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Understanding the mesengenic process and the differentiation factors of mesenchymal stem cells is a great challenge for biologists, since it has lots of potential medical applications, particularly in cell-based therapy and tissue engineering. This interdisciplinary work is a contribution to a project which objective is to define the influence of mechanical strain on the fate of these cells.

A Bio-MEMS has been previously developed for these assays. The goal of this Master thesis was to design a solution that enables a partial horizontal immersion of the silicon chip in the culture solution while keeping the electrostatic comb-drives actuators dry (Figure 1).

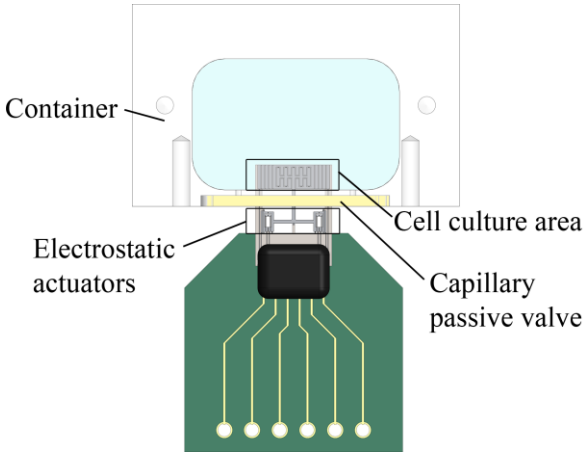

Figure 1: Main requirement: the cell culture area is immersed in the culture solution while the actuators are kept dry outside of the container.

After a preliminary feasibility study, a setup based on the principle of the capillary passive valves has been imagined and fabricated (Figure 2). In addition to the container and the valve, it includes a mobile adjustable holder and an easy way to plug the PCB without the need of any welding.

Due to its innovative operating principle, this system has a great flexibility and can be used for several other applications and MEMS designs. In addition to technical specifications, it perfectly fulfills the restrictive biological requirements.

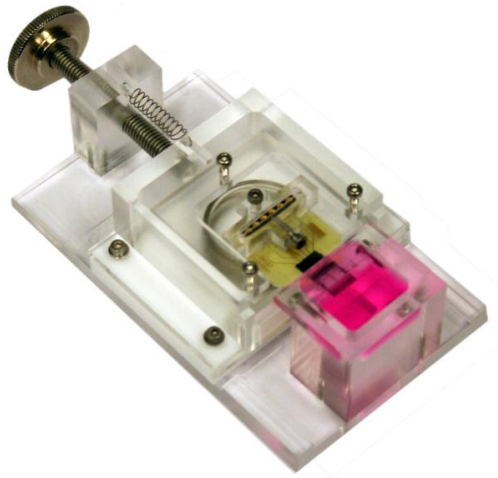

Figure 2: Final setup design: the silicon chip is partially immersed in the culture solution, demonstrating the good performance of the capillary passive valve.

Finally, a preliminary characterization of the MEMS device has been achieved. It showed the proper operation of the chip in liquid and highlighted differences in the amplitude response when the chip is partially immersed or not. These successful tests confirmed the good performance and the reliability of the setup. Hence, real assays on cells can now be considered.