The study of mechanical effect on cells is a growing point of interest as these properties play important roles in many biological process such as cell differentiation, apoptosis, attachment … In order to study the effect of stress on cells, a new macro-size mechanical device (Tweezers), a tweezers holder, a cells holder and a monitoring system have been developed. The test of a cell hasn’t been achieved during the project time-lapse but promising mechanical test on silicon have shown the feasibility of using tweezers for mechanical study of cells.

**Introduction**

Developing a new technique for mechanical characterisation of single cell require to develop not only the tweezers but also all the parts of the set-up, the sample, the micro-system holder, the control and analysis. Such system will enable many types of experiment and will therefore try to characterise the mechanical properties of the different part of the cytoskeleton.

**Experimental set-up**

The tweezers are the main components of this set-up and is made from silicon through chemical etching. It use two Comb-Drives (1) as actuators, one capacitive sensor (2) for measuring the displacement of the mobile tip (3) and finally four folded beam as suspensions (4).

A cell is sensitive to many parameters such as temperature, CO2 concentration, Ca2+ concentration… and may interfere with the health or even the mechanical property of the cell. Therefore two cell holders controlling the environment and the tweezers enabling the tweezers to test the cell has been designed.

**Test on Silicon Rubber**

In order to check the feasibility and accuracy of the system, a test on silicone has been manageable.

By comparing the calibration curve of the displacement (blue) and the displacement curve with the silicon (red), we can derive the force applied and consequently the Young modulus (around 1 Mpa).

**Test on Cells**

Finally, a first approach on cell has been carried out. We’ve been able to manipulate, and to apply compressions on fibroblast cells of 12 microns diameter. However, accurate measurement has not been achieved when the tips are in the medium.

Pictures representing the compression and relaxation of a single fibroblast cell.

**Future works**

Some improvement on the tweezers design will have to be tested as well as improvement on the protocol. These improvement will also have to be follow by a better manipulation control through a 3 axis actuator.

---

Master Project, spring 2010

Rémy Tourvieille de Labrouhe

Micro Nano Electro Mechanical Systems