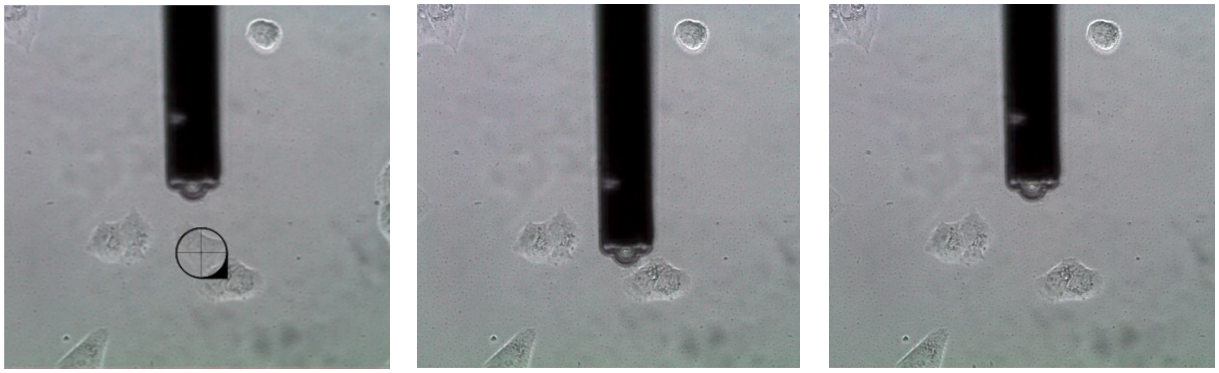
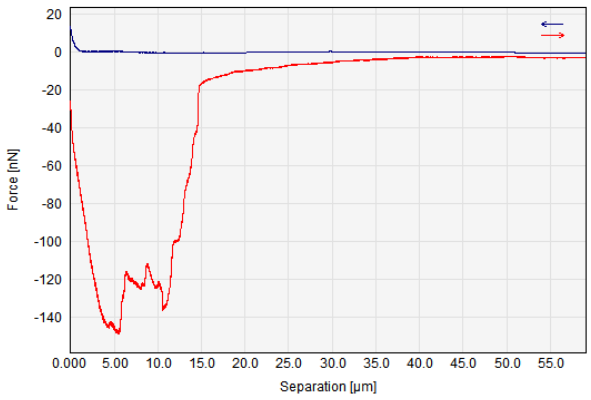
Example of single-cell force spectroscopy using FluidFM

Experiment recorded at Harvard Center for Nanoscale Systems (CNS)

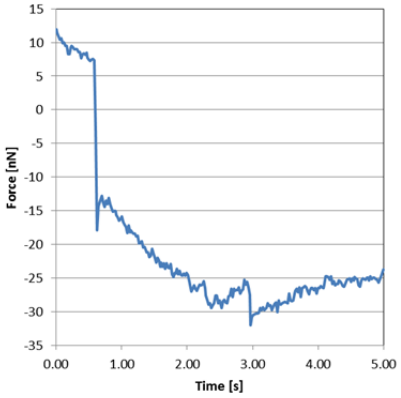
This application note shows an example of a single cell force spectroscopy experiment using FluidFM. It nicely demonstrates that FluidFM is capable to attach cells to a channeled cantilever in mere seconds by application of underpressure via the channel.



In the Cytosurge control software, a cell can be selected by placing a cross-hair over it. After this, the cantilever is moved over the cell and spectroscopy starts. Because of the long travel lengths required in vertical direction, a closed-loop Z-piezo with 100-µm range was used. This piezo moves the sample up towards the cantilever and keeps it there for 5 seconds, during which the application of an underpressure is started. Then, the sample is withdrawn with a predefined speed (here 5 µm/s). At the end of the experiment, the cell is still attached to the cantilever, but can be quickly released by a brief application of overpressure. Sample courtesy: HeLa cells were supplied by Dr. Mingtan Hai, Harvard Center of Nanoscale Systems. Watch a movie of the entire experiment on **YouTube**.



Approach (blue) and retraction (red) curves of the adhesion experiment shown, as analyzed and graphed with SPIP.



Deflection change during the 5 s pause. The large jump after 0.5 s is caused by the pressure application.

FluidFM cantilevers can be used for sequential measurement of tens of mammalian cells or hundreds of yeast cells [1,2], as the cells can be removed from the cantilever by application of an overpressure. This does however require the application of an anti-fouling coating to the cantilever prior to the experiment. If a cell remains attached to the cantilever, it can be removed by placing the cantilever in a bath containing trypsin or potassium hypochlorite for a few seconds. Without anti-fouling coating, such a cleaning procedure would be necessary for each cell that is measured.

1. Potthoff E, Guillaume-Gentil O, Ossola D, Polesel-Maris J, LeibundGut-Landmann S, Zambelli T, and Vorholt JA (2012) Rapid and Serial Quantification of Adhesion Forces of Yeast and Mammalian Cells. PLoS ONE 7(12): e52712. doi:10.1371/journal.pone.0052712

2. Potthoff E, Franco D, D'Alessandro V, Starck C, Volkmar Falk, Zambelli T, Vorholt JA, Poulikakos D, and Ferrari A (2014) Toward a rational design of surface textures promoting endothelialization. Nanoletters doi: 10.1021/nl404739

Also see Nanosurf application note AN00749 or visit http://support.fluidfm.com/hc/en-us.

Nanosurf CYTOSURGE®