Investigating Cell-Substrate and Cell–Cell Interactions by Means of Single-Cell-Probe Force Spectroscopy

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Cell adhesion forces are typically a mixture of specific and nonspecific cell-substrate and cell–cell interactions. In order to resolve these phenomena, Atomic Force Microscopy appears as a powerful device which can measure cell parameters by means of manipulation of single cells. This method, commonly known as cell-probe force spectroscopy, allows us to control the force applied, the area of interest, the approach/retracting speed, the force rate, and the time of interaction. Here, we developed a novel approach for in situ cantilever cell capturing and measurement of specific cell interactions. In particular, we present a new setup consisting of two different half-surfaces coated either with recrystallized SbpA bacterial cell surface layer proteins (S-layers) or integrin binding Fibronectin, on which MCF-7 breast cancer cells are incubated. The presence of a clear physical boundary between both surfaces benefits for a quick detection of the region under analysis. Thus, quantitative results about SbpA-cell and Fibronectin-cell adhesion forces as a function of the contact time are described. Additionally, the importance of the cell spreading in cell–cell interactions has been studied for surfaces coated with two different Fibronectin concentrations: 20 µg/mL (FN20) and 100 µg/mL (FN100), which impact the number of substrate receptors.

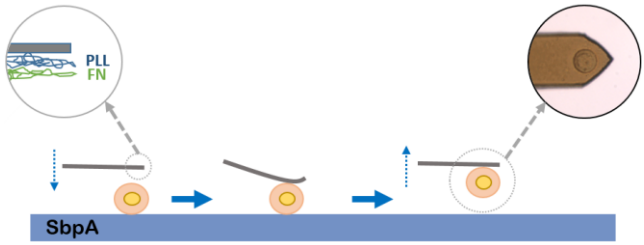

Figure 1: Schematic cell capturing process: the chemically modified flat cantilever is placed in contact with an individual MCF7 cell which stands on top of the SbpA-coated substrate.