Atomic Force Microscopy as a precision tool to study cell mechanics and adhesion

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Atomic Force Microscopy (AFM), operated in Force Spectroscopy mode, has become a standard tool for studying mechanical properties of soft materials at the nanoscale by sample indentation experiments. In such conditions, the AFM tip is restricted to move perpendicularly to the sample of interest (Z), with a high accuracy in its XY positioning. Tip displacement occurs under controlled approach/retract speeds and maximum loads in contact. Furthermore, both the thermodynamic conditions and the type of specific/non-specific interaction to be characterized can be adapted on demand, either by temperature adjustment or by chemical modification of the measuring probe, respectively[1]. The capability of an AFM to accurately manipulate samples also permits direct quantification of cell–substrate adhesion forces by means of the so called “single-cell probe force spectroscopy”, where a living cell is used as probe[2-3]. Appropriate analysis of the Force vs distance curves obtained allows extracting various mechanical parameters attending to the segment of the curve chosen: Young’s modulus and stiffness (approach), maximum adhesion force (retract) and rheology-related stress relaxation and creep compliance –strain- (pause in contact)[4-5]. Combination of these complementary features ensures a rather complete characterization of the (bio)material of interest, as shown in this work.

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