Mechanobiology: Non-imaging Applications of AFM in Cell Biology

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Measurement of the dynamic mechanical characteristics of living cells can often reveal surprising insights into cell biology in addition to quantifying material properties. The atomic force microscope (AFM) is a powerful nanoscale imaging device but its split-personality also allows for non-imaging mechanical approaches which have powerful applications when studying the biology of living cells. The AFM is well suited to measuring dynamic changes in the mechanical properties of cell membranes as well as applying controlled forces to living cells and tissues. This creates both passive and non-passive approaches to cell mechanics through measurement of material properties in addition to controlling and/or directing biological responses through applied force. In this talk I will present recent work from the London Centre for Nanotechnology in which the dynamic mechanical properties of living cells are measured and altered with combined fluorescence/confocal-AFM approaches. The results reveal surprising insights into biochemical signalling pathways as well mechanical dynamics during biological processes. Examples will be provided detailing how AFM can be used to detect and/or alter biological processes in single cells and tissues during apoptosis, cardiac contractions, primary neuron mechanotransduction, and organelle rearrangement in response to applied loads.