

## Stiffness tomography

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The atomic force microscope (AFM) has initially been developed to image at high resolution non-conductive samples. It appeared later that the instrument can also be operated as a nano-indenter to gather information about the mechanical properties of the sample. In this operating mode, the deformation of the cantilever is displayed as a function of the indentation depth of the tip into the sample. By processing this curve with theoretical models such as those of Hertz or Sneddon, it is possible to estimate the Young's modulus of the sample. However, such a processing has the drawback to sum the mechanical contribution of all the structures encountered by the tip along its indentation path. We recently noticed that dividing the indentation curve in parts and by applying the Hertz or Sneddon model on each of them one can detect the presence of structures located along the indentation path according to their stiffness.

This new imaging mode has been tested on different cell types such as neurons, macrophages, plant cells and bacteria. The experiments not only consisted in recording static data all over the samples but also in following the changes occurring on living organisms after the injection of various chemicals into the AFM imaging chamber. Applied onto living nerve cells the technique highlighted the depolymerisation of actin cytoskeleton underneath the cellular membrane, the incorporation of foreign bodies into macrophages, the migration of stiff materials into the cell wall of plant cells or the modifications of the mechanical properties of bacteria following their exposure to antibiotics.