We show that the atomic force microscope can be used to perform nanoscale spectroscopy and microscopy by directly detecting near field optical forces. The force and force gradient modulation on a AFM tip can be translated to a cantilever vibration and detected using the standard AFM optical detection technology. In initial experiments our system was used to detect electronic resonances of single molecules and record their images. The technique can also be used to directly map near field electromagnetic field distributions at nanometer resolution.

In standard Raman spectroscopy, the Raman effect is observed by irradiating a sample with an intense light source and detecting the minute amount of frequency shifted, scattered, light. We demonstrate that Raman molecular vibrational resonances can also be detected directly through a mechanical near field force measurement. We create a force interaction through optical interaction between stimulated, Raman excited, molecules on a surface and a cantilevered nanometer scale probe tip brought very close to it. Spectroscopy and microscopy on clusters of molecules have been performed. What appears to be single molecules within such clusters are clearly resolved in the Raman micrographs.