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Optomechanical atomic force microscope

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In the scanning probe microscope system, the weak signal detection of cantilever vibration is one of the important factors affecting the sensor sensitivity. In our current work, we present a novel design concept for an atomic force microscope (AFM) combined with optomechanics with an ultra-high quality factor and a low thermal noise. The detection system consists of a fixed mirror placed on the cantilever of the AFM and pump-probe beams that is equivalent to a Fabry–Perot cavity. We realize that the AFM combined with an optical cavity can achieve ultra-sensitive detection of force gradients of 10ˆ−12 N mˆ−1 in the case of high-vacuum and low effective temperature of 1 mK, which may open up new avenues for super-high resolution imaging and super-high precision force spectroscopy.

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