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**Direct detection of force gradient using atomic force microscopy with very small oscillation amplitude** TOSHU AN<sup>1</sup>, ATSUSHI NOMURA, TAKAHIRO NISHIO, TOYOAKI EGUCHI, KOTONE AKIYAMA<sup>2</sup>, YUKIO HASEGAWA, The Institute for Solid State Physics, The University of Tokyo — Using a quartz, which has a self-sensing capability, simple configuration of atomic force microscopy (AFM) is realized, and because of its high stiffness frequency-modulation (FM) operations with a small oscillation amplitude below 100 pm is possible. The small amplitude AFM operation enhances sensitivity of short range forces. Moreover, a force gradient can be directly detected from force vs. distance measurements. We carried out FM-AFM at low temperature (LT) in ultra-high vacuum using a quartz length-extension resonator with a tungsten tip (Spring constant and resonant frequency of the resonator are 540 000 N/m and 1 MHz, respectively) (An et al., APL **76**, 133114 '05). The system was simply made by attaching an extra electrode to the tip-holder of our LT-scanning tunneling microscope cooled by <sup>3</sup>He (APL **88**, 113115 '06). Direct detection of the force gradient was performed on the Si(111) 7x7 surface using very small oscillation amplitude of 70 pm at 2.4 K.

<sup>1</sup>PRESTO, Japan Science and Technology Agency

<sup>2</sup>present address, Institute for Materials Research, Tohoku Univ.

Toshu An  
The Institute for Solid State Physics, The University of Tokyo

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