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Low temperature AFM/STM for characterization of Si:H(111) surfaces and measurement of subsurface donors PAVEL NAGORNYKH, MICHAEL DREYER, BRUCE E. KANE, Laboratory for Physical Sciences, University of Maryland, College Park — Hydrogen terminated Si(111) surfaces can be prepared to have a very low density of defects, manifested in mobility values for surface electrons as high as 100,000 cm2/Vs in gated FETs [1]. Using such surfaces, it may be possible to detect and manipulate single subsurface donors and their states. Achievement of such control could serve as a step in development of silicon-based quantum computing, and low temperature AFM is considered a candidate for such measurements. In order to do this type of experiment, we have converted a low temperature UHV STM into AFM/STM by using a tuning fork as the AFM sensor. Signal from the fork is amplified by a low temperature home-made preamplifier, which was used to decrease capacitive noise coupling. The shift in resonance frequency of the fork's signal serves as a control signal for AFM scanning. In case of STM mode, current through a tungsten tip attached to one of the prongs of tuning fork is used as a feedback control. Current progress in imaging of Si:H(111) by using our system at low temperatures($\sim$ 4K) will be discussed in detail.

[1] Robert N. McFarland et al., Phys. Rev. B 80, 161310(R) (2009)

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