Abstract # 806 **Electronic Transport Properties of Silicon Surfaces**[1] **Session: SS7+EM**

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Abstract:

Most of our information about surface electronic properties has come from spectroscopic measurements and first principles electronic structure calculations. Direct measurements of transport properties of ultrathin films have revealed interesting physical properties, including quantum size effects. However, to correctly measure the surface or thin film conductivity, the conduction path through the bulk or substrate must be eliminated. We attempt to accomplish this by using crystalline silicon of "silicon on insulator" (SOI) material. Using STM, we have recently shown that 40 nm-thick Si(100) layers on SOI can be prepared with a comparable degree of structural perfection as the surfaces of bulk Si.[2] For these SOI films, we also observed that at room temperature, LEED spots drift and gradually disappear during prolonged exposure to the electron beam, indicating that the ultrathin Si top layer is fully depleted of mobile carriers, i.e. non-conducting. This leaves surface states as the only conduction channel. We have measured the surface conductivity of the Si(100)2x1 reconstruction on SOI as a function of temperature and Si film thickness during exposure to molecular oxygen using a four-point probe technique in ultrahigh vacuum. The oxygen induced conductivity changes strongly depend on the Si film thickness ($\Delta\sigma = -1.75\times10^{-5}(\Omega^{-1})$ for 40 nm and ($\Delta\sigma = -9.219\times10^{-6}(\Omega^{-1})$ for 90 nm thick films at room temperature. Differences are also observed in the temperature dependence, with possibly significant surface contributions to total sheet resistance at low temperature. These results indicate a correlation between transport properties and surface states, which will be discussed.

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[2] K. C. Lin et al., Appl. Phys. Lett. **72**, 2313(1998).

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