Abstract Submitted
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Temperature Dependence of Lateral Charge Transport in Silicon Nanomembranes[1] WEIWEI HU, SHELLEY SCOTT, R.B. JACOBSON, PORNSATIT SOOKCHOO, DONALD SAVAGE, MARK ERIKSSON, MAX LAGALLY, Univ of Wisconsin, Madison — Thin sheets of single-crystal silicon (nanomembranes), electrically isolated from a bulk substrate by a dielectric layer, are an exceptional tool for studying the electronic transport properties of surfaces in the absence of an extended bulk. Under UHV, we measure the conductivity, and a back gate allows us to look into the depletion region, where we can determine the minimum conductance. For hydrogen-terminated Si(001) NMs, for which the surface has no conductivity, the minimum conductance decreases with decreasing NM thickness (220-42nm), demonstrating the reduction in carriers for thinner NMs. For the clean Si(2×1)surface, mobile charge exists in the $\pi^\star$ surface band [1]. For thicknesses below 200nm surface conduction dominates, rendering the thickness independence of the minimum. We determine a surface charge mobility of $\sim$50cm^{2}V^{-1}s^{-1}[2]. We have measured the temperature dependence of the conductance of a 42nm thick HF treated SiNM. The results show that the Fermi level is pinned 0.21 $\pm$0.01 eV below the conduction band minimum, in agreement with XPS results [3].

[1] P. P. Zhang, et al., Nature 439, 703-706 (2006);
[2] W. Peng, et al., Nature Commun. 4, 1339 (2013);
[3] R. Schlaf, et al., J. Vac. Sci. Technol. A 17, 164 (1999).

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