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Electron transport of nanoscale P-donor wires in silicon[1] T.-C. SHEN, Utah State University, S. J. ROBINSON, J. R. TUCKER, University of Illinois at Urbana-Champaign — Three dimensional carrier transport in doped semiconductors has been extensively investigated. However, transport in low-dimensions is much less clear because of the difficulty to confine dopant distribution in a crystal. In the past few years we have created 2D embedded dopant sheets by exposing Si(100) surfaces to phosphine molecules in ultrahigh vacuum followed by growing epitaxial silicon over-layers at room temperature. Electron density in these delta layers can be as high as $\sim$1.5x10^{14} cm^{-2}. We find that surface roughness dictates the carrier mobility and activation, even though all surfaces are atomically clean and locally ordered. Furthermore, applying STM e-beam lithography on a single-layer H-resist enables us to define P-donor wires at widths from 200 nm to 5 nm in 2-terminal device templates. The As-implanted electrodes in the device templates provide ohmic contact with P-donor wires. In this presentation we will discuss our electrical and magneto-resistance measurement of various P-donor nanostructures at cryogenic temperatures. The goal of this research is to apply 2D P-donor patterns as building blocks for nanoscale integrated circuits.

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