Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Measurement of mesoscopic Si:P delta-doped devices fabricated by rapid STM hydrogen depassivation lithography via field-emission M. RUDOLPH, S.M. CARR, G. SUBRAMANIA, G. TEN EYCK, J. DOMINGUEZ, M.P. LILLY, M.S. CARROLL, E. BUSSMANN, Sandia National Laboratories — Recently, a method to fabricate nanoelectronic and quantum devices has been developed that utilizes scanning tunneling microscopy (STM) to place dopants (P) into Si with deterministic atomic-precision. Dopant placement is achieved via STM hydrogen depassivation lithography (HDL). Typically HDL is performed in a low-voltage tunneling mode where electrons desorb one H at a time, which requires extremely slow scan rates. Here, we introduce a high-voltage field-emission HDL, increasing patterning scan rate by an order of magnitude. Using the field-emission mode, we fabricated several HDL-patterned Si:P delta-doped devices, including a microscale multi-terminal Hall Effect device and a nanoscale quantum point contact. Low temperature transport measurements of the Hall device reveal a dopant density of 10^{14} cm^{-2}, resistance of 2 kΩ/square, and mobility of 30 cm^2/Vs. The quantum point contact showed a blockaded voltage range of 80 mV, comparable to other similar devices patterned using conventional HDL. This work was performed, in part, at the Center for Integrated Nanotechnologies, a U.S. DOE, Office of Basic Energy Sciences user facility. The work was supported by the Sandia National Laboratories Directed Research and Development Program. Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a Lockheed-Martin Company, for the U. S. Department of Energy under Contract No. DE-AC04-94AL85000.

Martin Rudolph
Sandia National Laboratories

Date submitted: 14 Nov 2013 Electronic form version 1.4