

# Improving Fabrication, Data Storage, and Sensing on H:Si(100)-2x1 via Atomically Precise Chemistry

Roshan Achal, Mohammad Rashidi, Jeremiah Croshaw, Taleana Huff,

Robert A. Wolkow

*Department of Physics, University of Alberta, Edmonton, Alberta, T6G 2E1,  
Canada*

*Quantum Silicon, Inc., Edmonton, Alberta, T6G 2M9, Canada*

*achal@ualberta.ca*

The hydrogen-terminated silicon surface has generated a lot of interest for its technological potential, ranging from atomic-scale electronics and quantum computation to ultra-high-density data storage. There is an ever-growing list of scanning probe microscope tools available to facilitate the precise fabrication of dangling bond (DB) structures on the surface through hydrogen lithography. As the progress towards practical technologies continues, the need for more scalable tools grows as well. Here, we present a method to correct fabrication errors and erase single DBs using atomically precise controlled chemistry to direct the reaction of individual hydrogen molecules [1]. We demonstrate the utility of this technique by rewriting data in an ultra-dense atomic-scale memory array without the use of a scanned probe. Further, we show that it is possible to use an extension of this technique to sense isolated molecular reactions with single electron sensitivity.

[1] R. Achal, M. Rashidi, J. Croshaw, T. R. Huff, and R. A. Wolkow, ACS Nano 14, 2947 (2020).