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**Towards single atom devices: weak localization in embedded phosphorus delta layers in silicon** JOSEPH HAGMANN, XIQIAO WANG, PRADEEP NAMBOODIRI, JONATHAN WYRICK, ROY MURRAY, M. D. STEWART, RICHARD SILVER, CURT RICHTER, NIST - Natl Inst of Stds Tech

— Key to the fabrication of devices based on the deterministic placement of dopants in silicon is the formation of phosphorus dopant monolayers and the overgrowth of high quality crystalline Si. Lithographically defined dopant delta-layers can be formed with a scanning tunnel microscope which can pattern device features on a hydrogen-terminated silicon surface by exposing Si dangling bonds at specific locations and implanting phosphorus at these locations with atomic precision. We describe advancements in the dopant formation and overgrowth processes necessary to produce prototypical few-atom devices in a controlled solid-state environment. The structure of the samples is determined from a suite of measurements that includes STM, TEM, and SIMS, and is directly correlated with the electrical properties measured by magnetotransport. We examine the effect of delta layer quality on the weak localization (WL) observed in these samples at low temperatures and low magnetic fields. We present parameters extracted from the fit of the WL feature to the Hikami-Larkin-Nagaoka equation that, alongside descriptions of delta-layer quality and dopant diffusion, demonstrate a method of testing these aspects of sample synthesis through electrical transport.

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