Optimizing the ground state charge characterization of dangling bond circuitry on hydrogen passivated silicon

With current CMOS technologies approaching their eventual performance limits, nanoscale atomic electronics are poised to provide the next-generation of devices. Several promising beyond CMOS platforms, such as dangling bond (DB) circuitry on hydrogen-passivated silicon require precise knowledge of the location of charges within fabricated atomic structures.[1] To achieve this, atomic force microscopy (AFM) measurements are typically used to determine the electron population of specific dangling bonds. A key consideration towards improving this ability and advancing DB circuitry is to ensure that the proximity of the AFM probe does not perturb the ground state charge occupation of circuit elements under investigation. While an interactive "write" regime for the scanned probe and less interactive "read" regime has previously been established, due to the dynamic nature of the system, it remains a challenge to make definitive ground state measurements.[2] Here, we directly compare AFM measurements with a minimally-perturbative scanning tunneling microscope charge sensing scheme to better establish the optimal parameter space for ground state measurements of charge occupation.[3] To achieve this, a DB wire was sequentially lengthened near a sensor DB, which allowed for the electronic detection of nearby changes of charge with single electron sensitivity. The same structures were also then investigated and compared with standard AFM characterization techniques. These results will be used to improve the charge characterization of DB structures and will eventually be directly compared to theory to improve the modeling of DB circuitry.

References

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