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Nanoscale Engineering of Structures and Devices on Surfaces

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The relentless increase in both density and speed that has characterized microelectronics, and now nanoelectronics, will require a new paradigm to continue beyond current technologies. One proposed such paradigm shift demands the ultimate control over the number and position of dopants in a device, which includes quantum information processing and variety of semiconductor device materials and architectures aimed at solving end-of-Moore's law issues. Such a work requires the development of a tool for the design of atomically precise devices on silicon and other surfaces, in hope of studying the effect of local interactions between atomic-scale structures, their microscopic behavior, and how quantum mechanical effects might influence nano-device behavior in very small structures. Demonstrations of remarkable 2D nanostructures down to single atom devices are reported here thanks to the development of scanning tunneling microscopy (STM) as an imaging and patterning tool. These include the formation of molecular chiral superstructures on metallic surfaces, as well as the atomic-scale depassivation of a hydrogen terminated surface with an STM, toward the incorporation of dopants in silicon. I will spend some time at the end, talking about my experience working at a national laboratory.

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