**Finding Needles in Haystacks: Scanning Tunneling Microscopy Reveals the Complex Reactivity of Surfaces**

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Many chemical reactions—etching, growth, and catalytic—produce highly faceted surfaces, from atomically flat planes to cubes, wires, tetrapods, and more. This faceting is a macroscopic manifestation of highly site-specific surface reactions. These site-specific reactions literally write a record of their chemical reactivity in the morphology of the surface — a record that can be explored and quantified with scanning tunneling microscopy.

I will present a number of examples of highly site-specific chemistry on silicon surfaces. In one example, the extremely high reactivity of one particular surface site provides a fundamental explanation for anisotropic silicon etching, a technology widely used in the production of micromechanical devices. In another example, I will explain the chemistry that underlies pyramidal texturing of silicon wafers, a technique that is sometimes used to decrease the reflectivity of silicon solar cells. I will show that a subtle change in chemical reactivity transforms a near-perfect Si(100) etchant into one that spontaneously produces nanoscale pyramids.

These experiments show that simple chemical reactions can enable an exquisite degree of atomic-scale control if only we can learn to harness them.

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