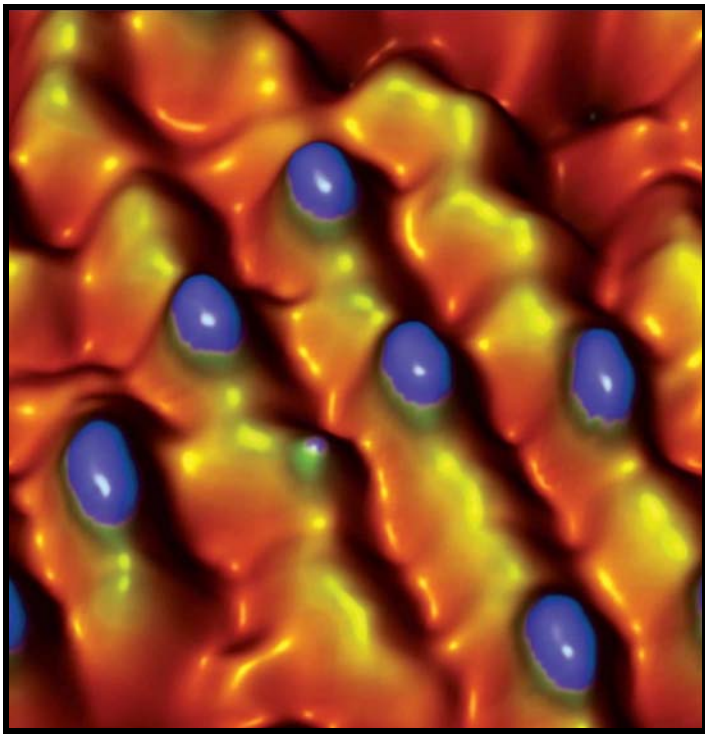
4.1.6 SINGLE MOLECULE RESONANT TUNNELING SPECTROSCOPY

N. P. Guisinger, N. L. Yoder, M. C. Hersam, "Probing Charge Transport at the Single Molecule Level on Silicon by Using Cryogenic Ultra-High Vacuum Scanning Tunneling Microscopy," *Proc. Nat. Acad. Sci.*, **2005**, *102*, 8838–8843.

In this work a NU-NSEC team used a custom-built, cryogenic, variable-temperature, ultrahigh vacuum scanning tunneling microscope to image and probe individual organic molecules on silicon. At cryogenic temperatures, the precision of these resonant tunneling spectroscopy measurements surpassed previous efforts accomplished at room temperature. These unprecedented results refine the design constraints for silicon-based molecular devices.

In an interesting twist, this study also provided insight into the chemical and electronic structure of organic molecules mounted on silicon substrates. While this study initially intended to use novel chemistry to improve electronics, the resulting molecular electronic device has also provided unique insight into the fundamentals of surface chemistry. In this manner, the work is likely to have impact in other fields, such as sensing, catalysis, and lubrication, where surface chemistry plays an active role.



This ultrahigh vacuum scanning tunneling microscopy image shows individual cyclopentene molecules mounted on a silicon surface. The image size is 3.2 nm by 3.4 nm. Resonant tunneling spectroscopy enables electronic characterization of this surface chemistry with single molecule precision.