# Silicon nanofabrication and carbon-based nanotechnology

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Scanning tunneling microscopy (STM) offers the unique opportunity to push the limits of nanotechnology by means of atomic precision control of individual atoms. Hydrogen resist lithography is an example of how the Lyding group at the University of Illinois at Urbana-Champaign has demonstrated the potential to push the atomic limit in silicon. In addition to opening new directions in silicon-based molecular nano technology, this work also led to the fortuitous result that deuterium can be used to dramatically retard hot-electron degradation effects in today's CMOS technology. Continued CMOS scaling has necessitated the search for new materials that address the limits of silicon technology. Carbon-based nanotechnology, in the form of carbon nanotubes (CNTs), graphene and atomically precise graphene nanoribbons (GNRs), has emerged as a promising area for post-silicon device applications. One of the major challenges in studying these carbon structures is a clean transfer method onto semiconductor substrates. The Lyding group developed the unprecedented clean deposition method of nonvolatile nanostructures onto clean surfaces known as dry contact transfer (DCT). In this method, nanomaterials are applied to an applicator and then carefully stamped onto the substrate in ultra-high vacuum (UHV). The success of this DCT method along with STM and scanning tunneling spectroscopy (STS) has revealed characteristics of nanostructures including orientation-dependent effects in single-walled carbon nanotubes, zigzag edge states in the electronic structure of graphene and atomic precision control of atomically precise GNRs. Nanometallization using STM addresses how these carbon nanostructures can then be fabricated in devices. This presentation provides compelling evidence of atomic precision using carbon nanostructures and offers future direction in order to continue advancing the limits of nanotechnology.

## Speaker Biography

Kaitlyn Parsons is a senior PhD candidate in electrical and computer engineering at the University of Illinois at Urbana-Champaign conducting research in Professor Joseph W Lyding's group. Her research is on scanning tunneling microscopy and spectroscopy of wet chemically synthesized graphene nanoribbons. She has presented at numerous conferences on her research including at the American Physical Society conference in Boston, Massachusetts and at the Materials Research Society conference in Phoenix, Arizona. She holds a Master of Science in electrical and computer engineering from the University of Illinois at Urbana-Champaign and two Bachelor of Science degrees in engineering physics and applied mathematics from the University of Colorado, Boulder.

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