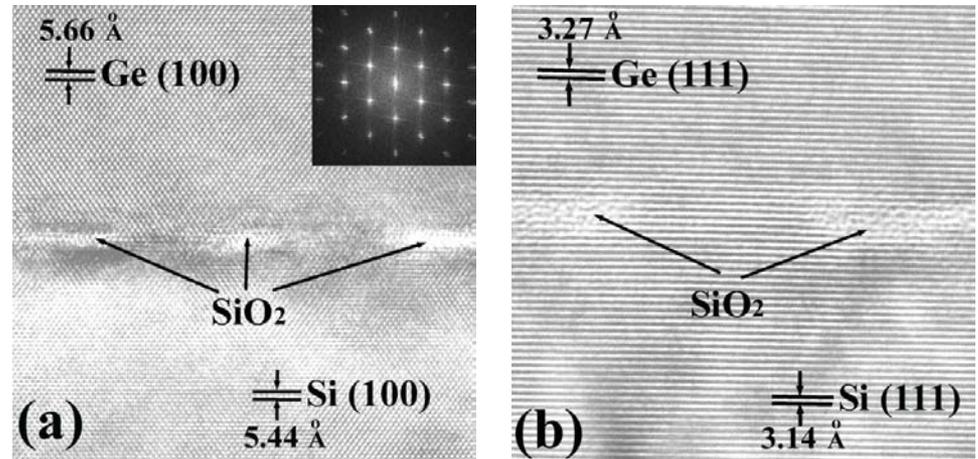


Growing Virtually Defect-free Germanium on Silicon

Sang M. Han, University of New Mexico, DMR-0094145

Hetero-epitaxy, the growth of defect-free crystalline films of arbitrary thickness, whose spacing of atoms is different from an underlying substrate, has been a long standing materials science challenge. The ability to grow such films opens the door to realization of a variety of advanced electronic devices—e.g., a thinking laser chip. What enables the growth of virtually defect-free Ge on Si here is the spontaneous formation of nanometer scale Ge windows created in a SiO₂ film through chemical reaction and subsequent thermal instability of GeO. The SiO₂ patches at the nanometer scale, in a way, behave like sponge pads.



Transmission electron microscope images of atomically abrupt Ge(100)-Si(100) and Ge(111)-Si(111) heterojunctions created by self-directed “touchdown” of nanoscale germanium seed pads through a 1.2-nm-thick silicon dioxide layer.

- Two manuscripts have been submitted to *Appl. Phys. Lett.* (1 accepted and 1 in review), and an invention disclosure has been filed on this subject.

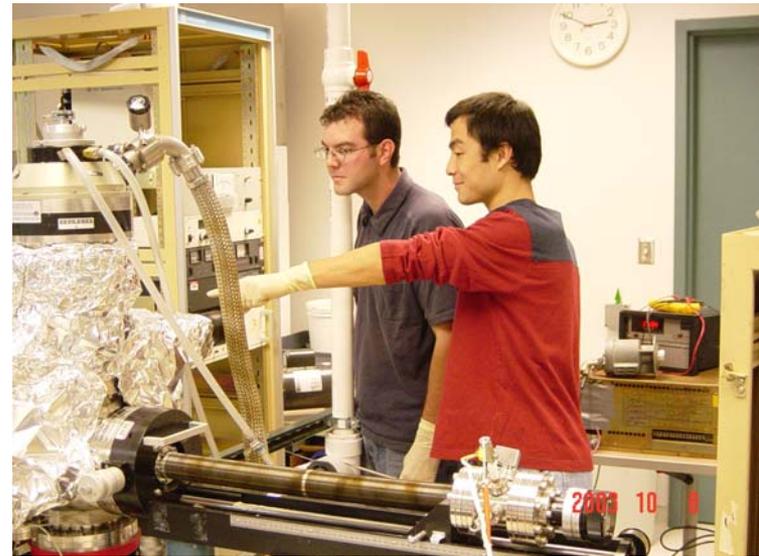
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Research Education:

The NSF support has provided for two graduate students (Qiming Li and Madhava Kosuri) and three undergraduate students (Angela Zivkovich, Kyle J. Solis, and Darin Leonhardt). Angela is currently pursuing a PhD in chemical engineering at UC Santa Barbara. She was one of the finalists of Rhodes Scholarship from New Mexico. Kyle has joined Prof. Han's research group in Fall 2003 to pursue a PhD in chemical engineering, and Darin has been conducting undergraduate research since Summer 2003.

Outreach:



Prof. Han promotes undergraduate research by traditionally under-represented students. Darin Leonhardt (left), an undergraduate student of Hispanic-descent, is learning ultrahigh vacuum experimental techniques from a 3rd year graduate student Qiming Li (right).