*Can You Imagine . . .*

. . . silicon transistors that promise impressive performance advantages over today's microelectronic devices.

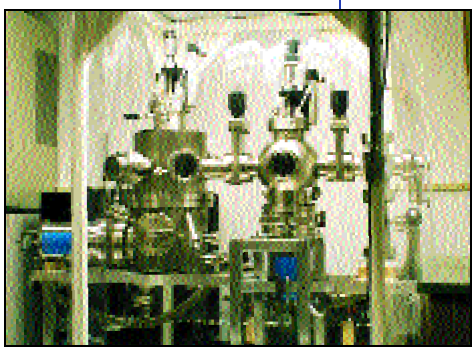
# SILICON MAKES A QUANTUM LEAP IN MICROELECTRONICS

NANODYNAMICS HAS TEAMED WITH INFINITE TECHNOLOGIES, INC., TO PRODUCE WORKING PROTOTYPES.

Conventional silicon transistors have enjoyed spectacular success over the past three decades, but size limitations of the technology threaten future progress. If transistors shrink much below 0.1 microns, the barriers that control switching functions will no longer operate properly. Also, as the devices shrink, the amount of heat within a chip builds up, requiring costly thermal management solutions.

To address these problems, NanoDynamics, Inc. (New York, NY), is building silicon-based superlattice devices called quantum transistors. These devices will use semiconductor heterostructures with thicknesses approaching those of an atom to overcome the heat build up common in integrated circuits. The razor-thin layers will allow the current to flow according to the rules of quantum tunneling without electron scattering, which causes heat. BMDO is funding this research through an SBIR Phase II contract for smaller, faster, and cooler electronics.

The most innovative aspect of this project is the use of silicon. Combining the low cost of silicon-processing technology and the high performance of column III-V semiconductor superlattices, this technology is an attractive replacement for many microelectronic devices. Because the technology also permits optical transitions in silicon, it ideally suits all light-using applications of solid-state devices, including lamps, light-emitting diodes, flat-panel displays, optoelectronics circuits, and photon detectors.



■ Pictured above is Nanodynamics' newly built fabrication chamber, which can control the fabrication process accurately down to fractions of an atomic layer.

NanoDynamics built the working diodes based on its BMDO-funded technology. Its next step connects the diodes in a working transistor. Toward this end, the company teamed with Infinite Technologies, Inc., to produce linear transistor prototypes. NanoDynamics and Infinite Technologies are jointly creating a new company, Dallas Linear Devices, with the goal of gaining 1 to 2 percent of the semiconductor market within five years. NanoDynamics currently estimates this market at $150 billion, possibly reaching $300 billion in the next six years.

## ABOUT THE TECHNOLOGY

To deposit the superlattice, NanoDynamics alternates layers of silicon and partial layers of silicon oxide. The structural differences between the two layer types produce localized strain regions in the semiconducting medium. These regions form quantum wells for the electrons in the medium. Applying voltages to the electrons in the wells enables such electronic functions as transistor amplification, diode current control, and switching. Theoretically, the quantum wells can be packed in high densities, allowing smaller transistors.