Restructured Microelectronics Program Based on New Intro Lab

In January, Virginia Tech began operating its new 1800 square-foot cleanroom and plans to make microchip fabrication experience a requirement for all EE and CpE undergraduates.

The new undergraduate teaching laboratory, on the top floor of Whittemore Hall, can accommodate up to 500 undergraduates per year and is one of the country's largest such facilities for second- and third-year undergraduates. "There is nothing special about it as a cleanroom, but as an undergraduate teaching facility, it is unprecedented," said Robert Hendricks, head of Tech's microelectronics task force. "Most university clean rooms are available to seniors and graduate students only," he explained.

The cleanroom was built to ISO Class 7 (Class 10,000) standards, but is operated at ISO Class 6 (Class 1,000) standards in order to give students experience in the more stringent protocols.

"We have developed an introductory microchip fabrication laboratory in which students process 4-inch wafers to create working nMOSFETs and other devices. We plan to make this course required of all students in computer engineering, electrical engineering, materials science and engineering, and physics." It has only freshman chemistry as its prerequisite. "No other school in the country exposes as many students to the process as we will."

The goal is to introduce the concepts of microchip fabrication in the sophomore year and then develop an option, or minor, in microelectronics engineering. This will be open to students from various branches of engineering and the sciences, and may be completed as part of the curriculum in each participating department, he said. "The entire EE and MSE offerings in microelectronics are being rewritten from top to bottom," Hendricks said.

"The option will involve about 15 credit hours of courses," he said. Required courses will cover solid state theory, semiconductor device fabrication technology, and semiconductor materials characterization. The specialization courses will include semiconductor device design, semiconductor processes, manufacturing operations, and special topics, such as nanofabrication/technology and photonic and optical materials.

The clean room and curriculum are part of a major restructuring and expansion of the university's education and research capabilities in microelectronics. "At Virginia Tech, we are committed to providing our students the necessary background to become leaders in microelectronics," Hendricks said. "Our goal is to have one of the top microelectronics programs by 2010."

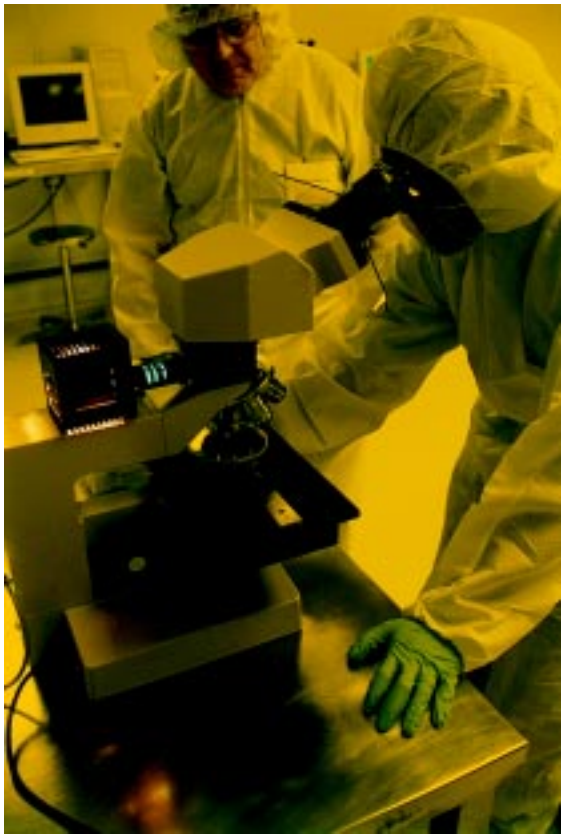
Four additional advanced undergraduate/graduate teaching and research laboratories are at various stages of planning and construction. A materials synthesis laboratory, a device fabrication laboratory (a Class 1,000 clean room), and a materials analysis laboratory are being established in Hancock Hall. In addition, device characterization laboratory (a Class 100 clean room) to measure electrical and optical properties is under construction in Holden Hall.

The Microelectronics Industrial Advisory Board has been very active in helping with laboratory planning and construction. "John Boidock (Texas Instruments, Inc.), Jim George (Motorola), and Joe Loring (Joe Loring & Associates, Inc.) volunteered to perform an engineering peer review of our plans and sent back a report with comments on some items that our engineers missed," Hendricks reported. "Our advisory board has helped guide us with some of the severe safety issues involved, and has been very gracious with technical advice."

The microelectronics task force that developed the new initiative consists of 10 faculty members from four departments and two colleges. "Microelectronics has become a multidisciplinary enterprise," Hendricks said. "The involvement of so many departments in this effort is really just a beginning," he said. "As we push the envelope of microelectronics, our answers will come from an even wider range of fields."

The microelectronics initiative is a combined education/research effort, and Tech is also expanding its research capabilities in the field, as described in the research section on page 50. The initiative involves adding faculty members in both teaching and research roles. As a result, two new faculty members joined the ECE department recently: Louis Guido, an expert in semiconductor materials and optoelectronic physics, who has a joint appointment in MSE; and Stephane Evoy, a specialist in nano-electromechanical systems.

"We are building this program for the long term," Hendricks concluded.



Facing page: Robert Hendricks, director of Virginia Tech's microelectronics task force, monitors air quality in the new microchip fabrication clean room. The laboratory was built as a Class 10,000 facility, but is maintained as a more stringent Class 1,000 operation. Left: A student in the new laboratory checks a device structure under an optical microscope.