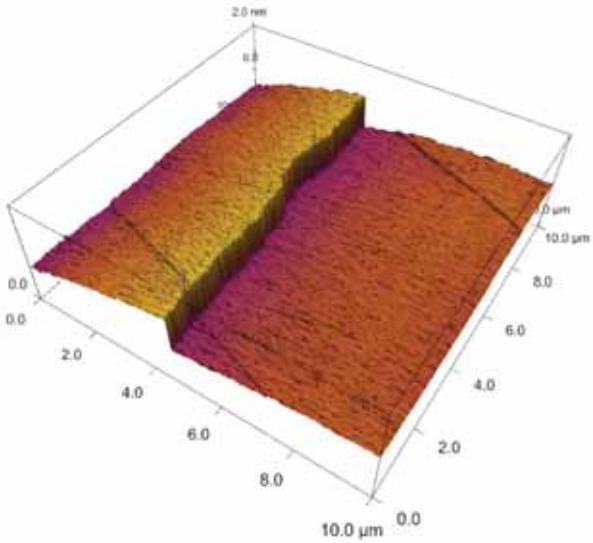


SPM image of a surface step on a tetracene crystal grown by Russ Lidberg and his student researchers using a vapor sublimation technique. The step is approximately one nanometer in height.

Atomic forces produce new views on life and matter

As the three-dimensional scan developed on the double screens before them, Bob Janisch and Cody Gebhardt began to comment excitedly about the quality of the image. Soon Janisch reached for his cell phone to ring Russ Lidberg, assistant professor in the Department of Physics, Astronomy and Engineering Science.

Earlier, the two had mounted a tiny sample of an organic crystal into the MFP-3D scanning probe microscope (SPM) and adjusted its settings. Operated within an acoustic isolation hood to help eliminate "noise," the probe, a cantilever equipped with a special tip, began rastering or scanning a targeted portion of the sample's surface in parallel lines — one atom's width at a time.

Automatically correcting for distortions, the atomic force microscope's (AFM) sensor precisely measured in nanometers the topographical characteristics detected by the cantilever's interaction with the sample. Gradually, digital data describing those characteristics became available and were rendered in numbers, graphs and images.

Since the high purity crystal they were examining was grown by Lidberg, along with other students in his research group, Janisch was certain he would want to know of their results. This research project by Lidberg and his group is focused on examining the properties of organic materials for use in future electronic and optical devices. Of specific interest in this experiment is the topography of the crystal and if surface defects affect the transport of an electrical charge on or near the surface. Favorable findings could lead to the use of such organic materials in a new generation of electronic devices.

The research is one example of nanotechnology, the science and technology of building devices, such as electronic components, from single atoms and molecules.

An AFM such as the MFP-3D is not typical on university campuses, and its presence in the new Microscopy Center in the lower level of Headley Hall has prompted potential collaborative projects with regional industry and research institutions.

> "We have this microscope and Mayo does not."

One such institution is the Mayo Clinic.

"We have this microscope, and Mayo does not," said Donald Neu, associate professor in the Department of Chemistry. Like Lidberg, Neu is interested in the surface properties of materials.

While Mayo's interests may pertain more to the surface properties of cells, such as cancer cells or the cells of plaques

From left, graduate student Carolyn Gamble and faculty members Matthew Julius and Donald Neu look at images of diatoms produced by the scanning electron microscope.

that build up in blood vessels, these too can be measured and imaged using the MFP-3D, which was installed in the Microscopy Center in July 2006. However, many biological specimens are imaged with the scanning electron microscope (SEM) installed in the center in May 2006.

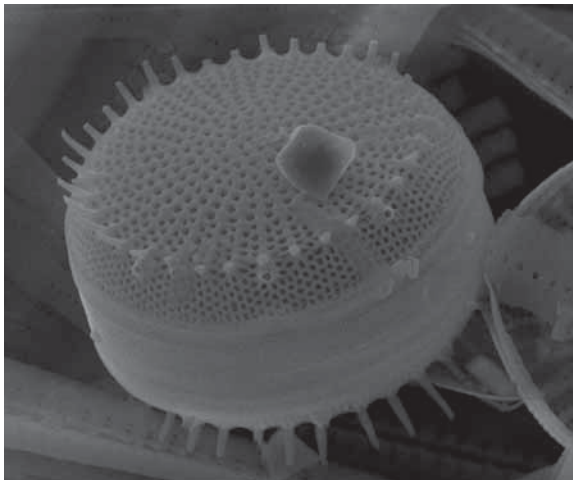
Another type of AFM, the SEM uses an electron beam to raster a sample. Its detectors then build up an image by mapping the secondary electrons which are emitted from the sample's surface due to excitation by the primary electron beam. While it generally produces images more quickly than the SPM, more care must be taken in preparing samples, which must then be placed inside a vacuum chamber for the scan. The instrument itself also requires a maintenance regimen, including the circulation of water to cool lenses and pumps.

Shortly after the SEM was installed, Matthew Julius, associate professor in the Department of Biological Sciences, used it to create images of diatoms in order to demonstrate its capabilities. Diatoms are a group of single-celled algae common in freshwater and marine environments. They are favorites of microscopy enthusiasts because of their unique, varied and sometimes ornate silica cell walls.

David DeGroote, dean of the College of Science and Engineering, said the use and development of the Microscopy Center has been a goal of the entire college.

"It's everyone's idea and has been years in the making," he said, adding that the idea was to buy technology with a wide range of applications that most if not all departments in the college would use in researching materials for a wide range of industrial processes and in the production of everything from cars and cell phones to medications and synthetic surgical membranes.

For more information about the capabilities of the microscopes, please go online to http://www.stcloudstate.edu/mme/facilities.asp.



SEM image of a diatom scanned by Matthew Julius.

Cody Gebhardt, left, and Bob Janisch mount a crystal sample for scanning with the SPM.

Biomedical science students acquire competitive edge

When Cody Gebhardt and Bob Janisch decided to become proficient at using the new scanning probe microscope (SPM) in the Microscopy Center in Headley Hall, they began quite a process.

"Working with the SPM has definitely been one of the most challenging things I've done in my college career," said Gebhardt, a senior majoring in biomedical science.

"It has quite a learning curve," said Janisch, also a senior in biomedical science.

Janisch said he wanted to complement his previous applied research experience with basic research experience before applying for research positions and medical school.

"So in August of 2006, I got involved with the SPM through Dr. Donald Neu, who suggested that I attend the initial training when they came to install it. From there I was hooked because the AFM presented the challenge I was looking for."

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As the image begins to emerge, Janisch, left, and Gebhardt begin to assess its quality.

Listing the complexity of the software, the fact that it can "magnify" surfaces features by a billion times, the care that must be taken with the fragile tips for the cantilever, and the cost of the instrument itself — a replacement would run about $200,000 — Gebhardt called its use "a difficult but fascinating practice." It's also a very useful practice.

"Choosing a career involving the use of an SPM could be very beneficial since SPMs are being used more and more to understand materials problems in many areas, including data storage, telecommunications, biomedicine, chemistry and aerospace," Gebhardt said.

Janisch, in fact, will be working with a cardiologist at the Mayo Clinic during summer 2007. They will use the SPM to study blood, blood clots and blood vessel tissue. He is also doing a structural biology crystallography research project with Bruce Jacobson, associate professor in the Department of Biological Sciences.

Janisch said the opportunities for research at St. Cloud State are equivalent to a "blank check" — he feels he has been given every means to become "very competitive in various fields.

"The AFM alone has allowed me to train and operate a piece of equipment that most universities reserve for post-docs," he said.

While the equipment "has helped tremendously," Janisch said the faculty is "even more phenomenal, because without people like Lidberg, Neu and Jacobson, who devote extra time to allow us these opportunities, the research and other chances to get ahead would just not exist."