

inside

Birck Nanotechnology Center

Multidisciplinary research
facility opens in 2005

Integrating two
environments

BAT Conference, Jan 21-23, 2004



Photo by John Weaver and James Cooper, Jr.

Birck Nanotechnology Center Going Up

Big Interest in Tiny Research

The prefix "nano" means one-billionth. A nanosecond is one-billionth of a second and a nanometer is one-billionth of a meter – approximately 10 atoms wide. These miniscule measurements, at almost incomprehensible scales, have opened a whole new world of scientific research. By enabling scientists and engineers to build electronic and mechanical structures literally atom-by-atom, nanotechnology is expected to revolutionize business, medical treatment, communications and other fields in everything from tiny computers, spacecraft and microscopic machines to microscopic life-saving medical devices.

At Purdue University's Discovery Park, construction is underway on a new \$58 million research building, the Birck Nanotechnology Center. At 187,000 square feet, it is the crown jewel of the 50-acre research park in West Lafayette, Indiana. The Birck Nanotechnology Center will include 30,000 square feet of clean-rooms in a mix of Class 10 (ten particles per billion at .3 micron), Class 100 and Class 1,000 rooms, and in bay/chase as well as ballroom configurations. The center will contain about 25,000 square feet of specialized laboratory space, along with offices, conference rooms and support facilities.

Convergence of Disciplines

The new facility is a prime example of a trend in thinking among the scientific community that diverse disciplines collaborate and work side-by-side, according to Ahmad Soueid, RA, HDR project principal for the new facility. Nanotechnology is bringing together different disciplines such as physics, biology, chemistry, pharmaceuticals, microelectronics, and manufacturing under one roof for to collaborate on research programs at the nano scale.

The Birck Center will host faculty, post-doctorates and graduate students from various disciplines on the Purdue campus and unite them with visiting researchers from academia and industry across the U.S. and worldwide.

This coming together of scientists at all levels and from all scientific disciplines, along with the building's cutting edge technology, is what makes the Birck Center so unique, Soueid said, adding that no less than 104 users showed up for the project's first planning meeting.

"A key mission of the Birck Center was to establish an environment in which people in many interdisciplinary programs could interact in unique ways," according to David B. Janes, associate professor of the School of Electrical and Computer Engineering and director of the Institute for Nanoelectronics and Computing "The variety of technical spaces available will make this facility nearly singular in today's university setting."

Very early in the project, HDR hosted a "Vision Workshop," attended by laboratory experts in bio-science and physical science research from across the

"The mission of the Birck Nanotechnology Center is to facilitate and promote interdisciplinary research in nanotechnology. The strategy by which we accomplish our mission is to provide infrastructure and to perform administrative functions to help create an interactive, multi-disciplinary community of scholars."

— James Cooper,
co-director of the Birck Center

country," said Janes, who at the time was research program coordinator for the Birck Center. "This helped us identify the key issues for our nanotechnology work and our strengths and opportunities." Some of the ideas from that meeting were actually incorporated into the facility's design, he said, adding that the subsequent building design process actually helped define more clearly the center's programmatic mission.

Collaboration is Key

HDR is providing full architecture and engineering services for the Birck Center, anticipated for occupancy in fall 2005. During programming and design, HDR met with Purdue University officials to determine functional goals and design parameters, and to understand the facility's intended and desired nanotechnology uses. The HDR team also looked at similar biotechnology, pharmaceutical research and microelectronics facilities.

Since nanotechnology is inherently interdisciplinary, researchers will share techniques, strategies and results. In effect, the Birck Center design promotes social engineering through the generous use of spaces for interaction and collaboration. The new facility is designed for a wide array of research programs, such as:

- Molecular beam epitaxy
- Modern optics
- Photoluminescence and Hall Effect characterization
- Silicon and silicon carbide epigrowth



The building's interior incorporates skylights and glass partitions to improve day lighting and foster better space for collaboration.



The exterior is brought to life with the use of varying materials, such as copper, which is representative of the microelectronics industry.

- Solid state devices and materials
- Ultrafast optics and fiber and communications
- VLSI integrated circuit design
- Robotics
- Biomedical programs

The Birck Center will have 88 lab modules for these specific research functions:

- Electrical/optical characterization
- Electron microscopy/surface analysis
- Nanostructures characterization
- Silicon processing
- MEMs/bioMEMs
- Biology
- Chemistry
- Instructional use
- Incubator/technology transfer

The Integration Challenge

HDR identified functional goals for the Birck Center, including an interface between cleanroom and research laboratories, the docking of biological materials on silicon substrates, protecting user and product, and building a link between basic and applied sciences. In addition to the specialized laboratories, the Birck Center will have two distinct cleanrooms — a microelectronics cleanroom and a bio-molecular cleanroom. The bio-cleanroom will serve as a link between the microelectronics cleanroom and biology laboratories.

However, microelectronics and bio-molecular cleanrooms are two very different species. Integrating the

two environments under the same roof is "not an easy mix," Soueid said, and it created numerous design challenges.

"You're controlling two different environments for different reasons," said Tom Gerbo, HDR laboratory project manager. "In the microelectronics environment, you want to keep out particulates to protect the product. In the bio-cleanroom, you want to control microorganisms and particulates to protect both user and product. In addition, cleaning protocols are very different. And pressurization for the two types of areas is the exact opposite - microelectronics needs a positive pressure to adjacent spaces, the bio cleanroom negative pressure. The Purdue biological cleanroom is negative to the microelectronics cleanroom and positive to the adjacent corridor.

"We've assimilated the key lessons for a complex project such as this," Soueid said.

"Estimate needs early, thoroughly understand the intent of the facility, research other solutions to similar requirements, accommodate evolving research, exhaust all concept options, and, above all, remain flexible. No one design solution works for every project, but for the Birck Nanotechnology Center we've arrived at a solution that will offer optimum flexibility and allow for future growth."

See back page for information on the upcoming Buildings for Advanced Technology workshop in Mesa, Arizona.

Buildings for Advanced Technology Workshop II

The second consecutive year of the Buildings for Advanced Technology (BAT) Workshop will take place January 21-23, 2004, in Mesa, Arizona. The conference is hosted by the Arizona State University and will be held in the Mesa Centennial Conference Center.

Discussions will focus on developing a connection between emerging science and a range of technical factors to consider during the design and construction of advanced technology facilities to support the next generation of nano-, bio- and micro-technology research and production.

This year's conference will extend the topics covered last year to include the following:

- Defining the Science Needs
- Outlining Trends and Developing Solutions
- Protecting the Investment

*Invited Keynote Speaker: Dr. James S. Murday,
Office of Naval Research*

The BAT Workshop is sponsored by:

- Arizona State University
- HDR
- CREATE
- Colin Gordon and Associates

For information about the workshop and registration, please visit: <http://www.nanobuildings.com/bat2>.

If you would like to be notified of similar events sponsored by HDR, please fill in the online form: <http://www.nanobuidlings.com/contactus/default.asp>.



Interior rendering of the Birk Center

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