The players in the advanced materials game

The Advanced Materials Research Laboratory at Clemson Research Park will — and in some cases already does — provide space and equipment for researchers in four "centers of excellence." They are photonics, fuel cell materials, nanotechnology and electron microscopy.

Photonics

Featured researcher: John Ballato, materials science and engineering

- Director, Center for Optical Materials Science and Engineering Technologies
- Interests include optical fibers and light-based communications
- Doctoral degree from Rutgers University in 1997
- Joined Clemson in 1997

John Ballato
photonics

By space, photonics will take up half of the new building. The heart of this research at Clemson is the 4-year-old Center for Optical Materials Science and Engineering Technologies, known as COMSET.

"This is the university's centerpiece facility for materials research specific to optics," Mr. Ballato said.

Three broad photonics research efforts at Clemson will move to the new building, including Mr. Ballato's specialty, fiber optics. He and others will work on the "last-mile" problem, which is that fiber optics work great for moving data over distances, but because of expense and fragility are not good for getting it from the street to the home or office computer.

A related problem, using light to store and move information inside computers, is the focus of advanced plastics researchers. Light is faster and cooler than electricity, but requires materials that are tiny, cheap and tough.

The third area is materials that react optically to environmental conditions, by turning color, for example. Such photonic sensors could instantly warn of chemical or biological agents.

Fuel Cell Materials

Featured researcher: Darryl DesMarteau, inorganic chemistry

- Tobey-Beaudrot Professor of Chemistry
- Leading researcher nationally on flourine chemistry, and has one group studying fluorinated plastics for use in fuel cells and battery storage
- Doctoral degree from University of Washington, 1966
- Joined Clemson in 1982 as a department head and lives in Clemson

Darryl DesMarteau
fuel cell materials

Fuel cells are one potential replacement for internal combustion engines, but making them cheap and reliable enough for the demands of cars and trucks has been a challenge.

Clemson chemist Darryl DesMarteau has been working on the problem for 15 years and while prognosticators used to say workable systems would be in cars this year or next, they now say 2010 is more likely.

"I wouldn't bet a lot of money on it," Mr. DesMarteau said.

The challenge is getting efficient fuel-cell operation while keeping costs down, which means getting the devices, which use hydrocarbons such as gasoline to produce pollution-free electricity, to work at higher temperatures.

Low-power fuel-cells work today in the 175-degree range, but the efficiencies required for car use requires them to operate in the 230- to 270-degree range, he said. At those temperatures, current polymer membranes — the key to high-powered fuel cells — degrade quickly.

Groups around the world are working on the problem, but Clemson's team may be unique in working with new fluorinated polymers, a class of chemicals that shows promise at higher temperatures. They also are trying to rework the chemistry of fuel cells to increase efficiency and lower the temperature requirement.

Nanotechnology

Featured researcher: Ya-Ping Sun, materials/organic chemistry

- Leslie Endowed Chair of Natural Sciences
- Among focuses are nanostructures and nanomaterials for optical, electronic and biomedical applications
- Doctoral degree from Florida State, 1989
- Joined Clemson in 1992 and lives in Clemson

Ya-Ping Sun
nanotechnology

Nanotech is one of the hottest research areas in American science, and carbon nanotubes are among the hottest material within nanotech. "Nano" refers objects measured in billionths of a meter — the scale of molecules — and carbon nanotubes have a variety of potentially revolutionary electrical and strength properties.

The Advanced Materials Research Building will have a facility to produce kilogram quantities of these tiny cylinders, far more than is available to Clemson researchers now, chemistry professor Ya-Ping Sun said.

The nanotubes initially will be produced through laser ablation, heating precursor ingredients with laser light, or arcing, basically the same technology welders use to bond metals. Eventually, some nano-materials will be made with chemical vapo-deposition, built up in layers as precursor gases condense onto a surface.

Some nanotech groups will work on materials for the National Aeronautics and Space Administration, specifically embedding nanotubes in polymers to add strength and anti-static properties to proposed "solar sails" for deep-space exploration, Mr. Sun said. Closer to home, nanofibers could help the space agency improve space suits for the next moon mission.

Nanomaterials researchers in the new building eventually should number 30 to 50, half of them new to the university, Mr. Sun said.

"Our slogan is, 'Get the space, and we will fill it,' " he said.

Electron Microscopy

Featured researcher: Joe Kolis, inorganic chemistry

- As university special projects director, oversaw development of electron microscope facility
- Studies novel inorganic compounds with unusual structures and properties, particularly under unusual conditions such as high temperatures and pressures
- Doctoral degree from Northwestern University in 1984
- Arrived at Clemson in 1985 and lives in Clemson

Joe Kolis
electron microscopy

The world-class electron microscopy facility is not a research project in its own right, but a service center for research efforts in and out of the research park, as well as outside academia entirely. Electron microscopes measure forces from electrons interacting with ultra-small objects to generate images on a scale smaller than possible using light.

Vibration-proof floors and extra-thick walls isolate the microscopes from the surrounding structure, ensuring researchers the best performance state-of-the-art machines can provide, said chemist Joe Kolis, the university's new projects director and the man who oversaw the building's construction. The machines are so sensitive not only are they affected by mere human speech, the resulting distortions can distinguish male and female voices, he said.

Each of the six current scopes cost between $500,000 and $1.5 million. While the research and development arms of many industries in the region are eager to have access to electron microscopes, the expense prevents them from setting up their own labs. Mr. Kolis hopes the Clemson Research Park becomes their preferred alternative, a way to outsource science.

"We're close to setting up one of the best facilities on the East Coast," he said.