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Green Chemistry: Researchers Win Environmental Protection Agency/American Chemical Society Award for Creative Chemistry

Two Georgia Institute of Technology faculty members who have collaborated for more than 15 years on sustainable chemical processes are among the winners of 2004 [Presidential Green Chemistry Challenge Awards](#) from the [U.S. Environmental Protection Agency](#) and the [American Chemical Society](#).

[Charles Liotta](#), Georgia Tech's vice-provost for research and dean of graduate studies, and [Charles Eckert](#), a professor in the [School of Chemical and Biomolecular Engineering](#), were honored for their development of benign tunable solvents that couple reaction and separation processes.

The awards, which also went to four companies, recognize "creative chemistry that shows promise for improving the environment." An independent panel of technical experts convened by the American Chemical Society judges the awards on behalf of stakeholders from the government, industry, academia and nonprofit sectors.

"We're using a systems approach to processing," explained Eckert, who holds the school's J. Erskine Love, Jr. Institute Chair. "We have used novel and tunable solvent systems to integrate the reaction and separation processes to facilitate the reduction of waste, allow the recycling of catalysts and use more benign solvents. We are developing methods that not only are more benign, but also have economic advantages in producing better products less expensively."



Georgia Tech faculty Charles Eckert (left) and Charles Liotta are among the winners of the 2004 Presidential Green Chemistry Challenge Awards from the U.S. Environmental Protection Agency and the American Chemical Society. Here, they are shown in their research laboratory.

For example, they use [near-critical water](#), which when heated to 275 degrees Celsius under pressure, dissolves non-polar organic chemicals that would be insoluble at normal conditions. “You can do a reaction with organic molecules, and when you want to separate the products, you just go back to room temperature and they separate out,” explained Liotta. “Water becomes a tunable solvent when you change the temperature and pressure.”



Using near-critical water instead of traditional acid-based processes eliminates the need for a neutralization step – and the resulting production of waste salts. “When you heat water, it tends to come apart to create acid and base that will catalyze reactions,” Eckert explained. “The acid and base go away by themselves when you cool the water.”

Georgia Tech faculty Charles Liotta (left) and Charles Eckert are among the winners of the 2004 Presidential Green Chemistry Challenge Awards from the U.S. Environmental Protection Agency and the American Chemical Society. Here, they are shown meeting with students.

Other examples of their sustainable technology include the use of supercritical carbon dioxide, and carbon dioxide-expanded liquids. Their most recent work focuses on techniques for asymmetric chemistry, such as the synthesis of pharmaceuticals or pharmaceutical precursors.

Despite recognition for their research, Liotta – a physical-organic chemist who is a Regents Professor in the [School of Chemistry and Biochemistry](#) – and Eckert – a chemical engineer – say their top accomplishment is giving their students an education in multi-disciplinary green chemistry issues.

“The reason we do research is because it’s such a good way to train students,” said Eckert, who joined the Georgia Tech faculty in 1989 after 24 years at the University of Illinois. “Interdisciplinary research is the vehicle for educating students about collaboration and partnerships to solve problems.”

For Eckert and Liotta, collaboration is much more than a pragmatic partnership to win research contracts. Though administratively part of two different schools, the two professors share laboratory space and house their students together, mixing graduate and undergraduate student chemists and chemical engineers in ways designed to break down traditional barriers.

“The major social and scientific problems we will face in the 21st century are going to require a multi-disciplinary approach looking at things from a variety of viewpoints, said Liotta, who has spent his entire career at Georgia Tech. “Our students are educated in cooperative and collaborative research with other disciplines.”

Liotta and Eckert work in Georgia Tech's [Ford Environmental Science & Technology Building](#), which was designed for just that kind of intermingling. Biologists, chemical engineers, atmospheric modelers, chemists, civil engineers and faculty with other backgrounds work in adjacent offices and laboratories, all part of a concerted effort to bring researchers together around environmental issues.

“The fact that Charlie Liotta and I are able to co-occupy lab space and co-direct students in a building devoted to the environment has made it much easier for us to have an impact,” Eckert said. “Georgia Tech is very supportive of collaborative work. I think it is very important that this award is being given for a multi-disciplinary collaborative effort.”

That collaboration extends beyond the laboratory into the Atlanta community, the state of Georgia and to industrial companies nationally and internationally, Liotta says.

“You can look at Georgia Tech both horizontally and vertically,” he explained. “Horizontally, our culture is to bring different disciplines together to attack real-world problems. Vertically, we build from fundamental to applied to commercialization and to economic development.”

The researchers look to industry not just for research support, but also for involvement with student education. “It’s a real partnership with the companies,” Liotta said. “They are also taking part in student development and making sure that what we teach has real-world application.”

The [Liotta-Eckert collaboration](#) has benefited from other outside support, including collaborators from institutions outside Georgia and the [Georgia Research Alliance](#), a public-private partnership that fosters economic development by investing in university faculty and instrumentation resources.

“The state has recognized that university research is the intellectual driver for economic development,” Liotta said. “We are fortunate to be at Georgia Tech and in the state of Georgia where there is such a forward-looking process.”

Liotta and Eckert met more than 20 years ago when both were consultants to DuPont. Liotta had a reputation for work in phase-transfer catalysis, which allows the reaction of molecules that are not soluble in a common solvent. Eckert’s background was in molecular thermodynamics and phase equilibria, and he was a pioneer in the use of supercritical fluids for separations and reactions.

At Georgia Tech, the two professors have not only combined their respective fields, but also merged their careers. “This has evolved into a fantastic relationship,” adds Liotta with a grin. “We just had the right chemistry to make it work.”

The awards were presented June 28 at a ceremony on Washington, D.C. Also winning the recognition this year were scientists at Jeneil Biosurfactant Company, Bristol-Myers Squibb, Buckman Laboratories and Engelhard Corporation.

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