by Anne Myers

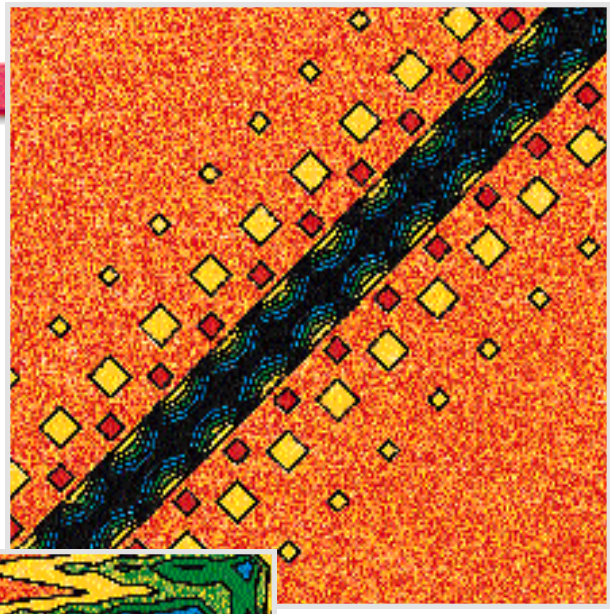
A Light and Lively Quartet

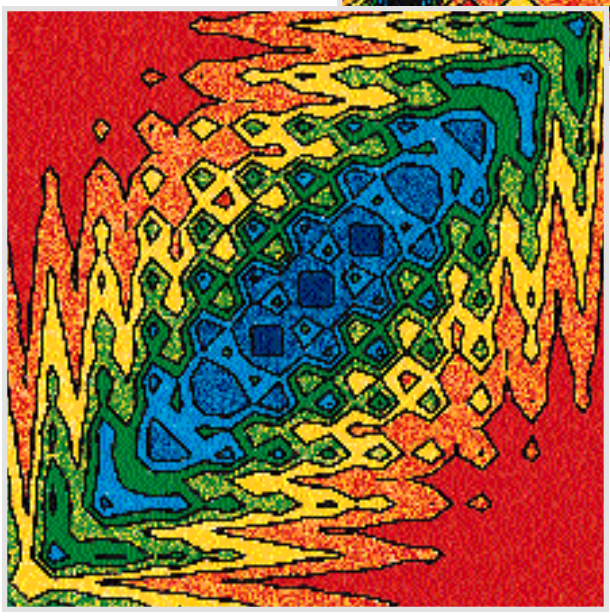
High school science students can produce their own atomic-level images of materials, thanks to the University of Rochester's Center for Photoinduced Charge Transfer (CPCT). Investigators affiliated with the CPCT developed a concept for a low-cost scanning tunneling microscope, which was refined into a production in collaboration with Burleigh Instruments, Inc., in nearby Fishers, New York. The CPCT maintains a "lending library" of these microscopes, which can be borrowed by high schools and colleges in the area.

In 1989, the National Science Foundation (NSF) established the first 11 Science and Technology Centers—including the University of Rochester's CPCT—to explore new modes of scientific research and education. The CPCT consists of a four-way collaboration among the university, Eastman Kodak Company and Xerox Corporation, both headquartered in Rochester, and NSF. Rochester's CPCT concentrates on photoinduced charge transfer: the conversion of light energy into potential energy in the form of separated electrical charge. This phenomenon is central to the physical and chemical processes that underlie many important modern technologies, including electro- and conventional photography.

This collaboration prospers by sharing resources. NSF provides about $2.1 million each year. The university provides laboratory and office space, access to its facilities for the industrial scientists, administrative support, and about $400,000 per year in faculty release time, tuition waivers, and cost-sharing on major equipment. A faculty member supported by the CPCT saves up to 67% in the costs of running a laboratory because of the savings from sharing resources. In addition, Xerox and Kodak provide access to their laboratories, specialized materials, and release time for their scientists—valued at a total of about $900,000 per year. This combination of talented scientists, advanced facilities, and financial support allows fast progress in basic research, education, and industrial technology.

To accomplish its research goals the CPCT employs small teams, each consisting of at least one senior scientist from the university and one from Kodak or Xerox, as well as graduate and postdoctoral students.





Light energy induces a nonlinear optical response in a 30-carbon-atom polymer chain.

The teams include chemists, physicists, and chemical and electrical engineers, who can use a wide variety of resources: the CPCT's facilities housed at the university's chemistry department, the laboratories of individual investigators at the university, and laboratories at Kodak and Xerox—all located within a 5-mile radius. In many cases, a project involves scientists from all three institutions.

"Kodak is a lot like many other U.S. companies that depend on products that have a very high technology content," said James W. Meyer, senior vice president and chief technical officer at Kodak. "The success that you have with these products requires a very good fundamental understanding of the basic mechanisms and science. That's where the center has a unique contribution to make. It is turning out to be very successful in terms of a collaboration and a new way of building this fundamental science understanding."

Many projects at the CPCT have produced useful findings. For instance, several projects examine photophysical processes in conducting polymers. These studies have revealed how charges form and travel through these polymers, which affects the design of light-emitting diodes and thin-film transistors. Other projects investigate the relationship between a dye's structure and its photophysical properties—a topic that applies to electro- and silver-halide photography. These studies, and many more, have generated more than 300 scientific publications from the CPCT.

Despite the CPCT's scientific success, one might expect strain in a collaboration between Kodak and Xerox—competitors in the image-reproduction industry. Nevertheless, Meyer said, "Two companies that might consider themselves competitors in imaging really can work well together and be members of a team." Leonard Brillson, who is manager of the materials research laboratory at Xerox, added, "There has been remarkably little friction. There are examples of scientists sharing fundamental information to the benefit of everyone."

Work in education may produce the CPCT's most enduring impact. The CPCT provides educational opportunities at all levels of scientific proficiency, from beginners to experts. In addition, the CPCT's educational impact stretches from local grade schools to distant countries.

Working scientists may also explore educational events sponsored by the CPCT. On September 15–17, the CPCT will co-host the "International Conference on Organic Electroluminescent Materials," sponsored by Japan's Ministry of International Trade and Industry. This conference is also open to the broader scientific community, although total attendance is limited.

Expanding outreach

The CPCT continually strengthens its impact on science and industry by expanding its collaborative efforts. For instance, the CPCT is involved in a particularly fruitful collaboration with the Institute for Molecular Science (IMS) in Okazaki, Japan.

Last February, 10 scientists from IMS visited the CPCT for a workshop to explore areas for collaborative research. Likewise, Greg Goodno, a graduate student at the CPCT, visited IMS for a week in February to learn new techniques in ultrafast nonlinear multiwave-mixing techniques for characterizing properties of materials. Goodno worked mainly with Keisuke Tominaga, an IMS scientist. Later in the spring, Tominaga came to the University of Rochester for a month to study theoretical aspects of these techniques with Shaul Mukamel's group. Throughout this year, Mukamel will be hosting four other IMS scientists who will be visiting for periods ranging from a week to several months. Later this year, CPCT postdoctoral fellow Dr. Deanna Hurum will visit Japan for several weeks to carry out ESR measurments on metallofullerenes in collaboration with Dr. Tatsuhisa Kato at IMS.

Anne B. Myers is professor of chemistry at the University of Rochester and director of the NSF Science & Technology Center, Rochester, New York.