Chemistry

From our reporters at the meeting in Washington of the American Chemical Society

Beyond the blue on a low budget

A team of chemists has developed a laser-based technique for producing extremely short-wavelength ultraviolet light. The required apparatus is easily built from commercially available components, so many researchers interested in studying ultraviolet effects on materials may no longer need to visit the few facilities that house synchrotron light sources. In addition, co-developer Richard N. Zare of Stanford University claims that their new light source generates coherent ultraviolet radiation that is purer and orders of magnitude brighter than similar radiation from synchrotron sources.

The new technique exploits the fact that a gas can interact with intense light to triple the light's frequency (or cut its wavelength to one-third the initial value). Zare and his colleagues start with a dye laser that produces orange light. A crystal frequency doubler cuts the light's wavelength to about 300 nanometers. When this light illuminates tiny puffs of argon gas injected into a vacuum chamber, short-wavelength ultraviolet light emerges. In contrast, a synchrotron generates light pulses by the acceleration of groups of electrons circulating at high speeds in a closed orbit.

By tuning the dye laser, the researchers can vary the output wavelength continuously from 97 to 102 nanometers. This falls within a range of wavelengths called the vacuum ultraviolet because air strongly absorbs such light. This is also the region in which hydrogen molecules first absorb energy. "At this wavelength, many materials ionize," Zare says. "Some are excited, and others fall apart. It's a region which chemists have wanted to get into because there's so much action." He concludes, "There are some very exciting opportunities now beyond the blue."

Reacting to an ultrasonic bath

For the last two years, Philip Boudjouk of North Dakota State University in Fargo has been exploring the ability of ultrasonic waves to speed up chemical reactions and to improve the yields of many industrial processes (SN: 4/17/82, p. 264). The results have been encouraging enough to interest several large companies, including Dow Chemical Co., and to show that the common ultrasonic cleaner, usually employed to clean items such as delicate instruments or jewelry, is likely to become an important laboratory tool.

Boudjouk has found that a variety of reactions are stimulated by ultrasonic waves, particularly those that require metal catalysts. These reactions include the addition of hydrogen to alkenes and alkynes in the presence of palladium, and reactions that produce important intermediates in the synthesis of many drugs. Boudjouk also reported the efficient synthesis of anilines from aromatic compounds under very mild conditions and similar improvements in producing silicon organic compounds. In many cases, reactions that normally needed high pressures and temperature could be done under milder conditions, at or near room temperature and atmospheric pressure, when the reagents were bathed in ultrasonic waves.

Double-punch antitumor treatment

Tumor cells of certain types rely on the amino acid glutamine far more than do normal cells. They use it, rather than glucose, as the major fuel source, as well as incorporate it into proteins and nucleic acids. Scientists have tried unsuccessfully to develop therapies that deprive cancer cells of their glutamine supply. Now Joseph Roberts of Sloan-Kettering Institute for Cancer Research in Rye, N.Y., reports that teaming up two of these approaches offers an attractive potential treatment.

Breast, lung and colon tumors, transplanted into mice with deficient immune systems, were inhibited or killed by a combination of an enzyme called glutaminase, which breaks down glutamine, and chemicals that compete with glutamine in its metabolic reactions. By itself, the glutaminase, which was isolated from soil bacteria, inhibited leukemias but not solid tumors. The glutamine antimetabolities (called DON and Acivicin) alone are effective against tumors only at doses so high as to cause severe side reactions in patients. But after glutaminase markedly reduces the glutamine concentration in experimental animals, low non-toxic doses of the antimetabolites are effective. Roberts says an important characteristic of the therapy is that tumors do not become resistent to glutaminase or the antimetabolites when used in combination.

Popweeds to polymers

The oil of an Arizona desert wildflower may partially replace petroleum as a renewable source for plastics, say researchers at Lehigh University in Bethlehem, Pa. Leslie H. Sperling and colleagues have been testing popweed *(Lesquerella palmeri)* oil for its ability to polymerize, forming strong chain-like macromolecules from a large number of relatively simple monomers.

By weight, popweed seeds are 30 percent triglyceride oil, a compound consisting of three hydrocarbon chains. Most triglyceride plant oils lack the chemical side groups necessary for polymerization. Like castor oil, already widely used in such products as paint and urethane rubber, popweed oil monomers contain a number of hydroxyl groups. These can react with side groups on nearby molecules to form polymers.

By polymerizing popweed oil by itself or with castor oil, the researchers made a soft, rubbery polyester. They also reacted popweed oil with brittle polystyrene, forming a new type of tough plastic.

Because popweeds thrive in agricultural wastelands, the scientists think its oil could prove a cheap, easily renewable source for some products now made from petroleum. The seed meal left over from extracting the oil could possibly be used for animal feed, they say.

Gee, your hairpencils smell terrific

Plants make it. People make it. Even oriental fruit moths make it. What is it? Methyl jasmonate, "long believed to be one of the most fragrant compounds around," according to Ritsuo Nishida, a biochemist at Kyoto University in Japan.

Nishida, along with entomologist Wendell L. Roelofs and flavor chemist Terry E. Acree, both of Cornell University's New York State Agricultural Experiment Station in Geneva, recently isolated and identified the heady chemical from the brush-like hairpencil organs that extend from the abdomen of the male moth, *Grapholitha molesta.* The male uses methyl jasmonate in a sex attractant that he squirts from his hairpencils onto a nearby female. "If he has the right smell, she responds by tapping him on the back," says Roelofs. "Then the male whirls around and bammo—more insects."

Jasmine flowers, lemons and pumpkin seeds also contain methyl jasmonate. Although cola and perfume manufacturers have synthesized the chemical for years, they have never been able to produce a scent as potent as the natural compound. Now scientists know why.

Methyl jasmonate can exist as one of four isomers, chemicals with the same type and number of molecules arranged slightly differently in space. "The isomer in the natural compound has 10,000 times the odor of the others," Acree told Science News. Yet this active isomer constitutes only 3 percent of the synthetic scent; the rest is virtually odorless. The researchers expect their findings will help entomologists better understand the chemical communication of insects, and will enable the perfume industry to cut the time and cost of producing "the queen of aromas."