Earth Science

Gas emissions from mowed grass

Lazy suburbanites now have one more excuse for letting their lawns grow wild. While pollution experts have long worried about the exhaust from gas-powered mowers, new research shows that the grass trimmings themselves release a burst of pollutants as they dry.

Past studies have shown that wounded grass leaves emit a long list of volatile organic compounds (VOCs), giving rise to the distinctive aroma that hangs over a freshly mowed lawn. Joost A. de Gouw, an atmospheric chemist at the University of Utrecht in the Netherlands, and his colleagues looked beyond the cutting to see what happens as grass dries. They clipped red fescue and Dutch white clover from a lawn, placed the clippings in a box under a 100-watt lightbulb, and measured the VOCs.

"The drying is more important in terms of emissions than the cutting process," says de Gouw. The drying grass gave off 10 times more VOCs than did freshly cut leaves, the researchers report in the April 1 Geophysical Research Letters.

The grass released (Z)-3-hexenol, (Z)-3-hexenal, hexenyl acetate, formaldehyde, methanol, acetaldehyde, acetone, and butanone. Some of these VOCs react speedily with other chemicals to form ozone gas and other components of smog.

A lab experiment alone can't resolve whether mowing lawns gives off enough VOCs to increase air pollution noticeably, says de Gouw. Because metropolitan areas have many sources of pollution, the compounds from mowed lawns may contribute relatively little to the noxious stew. The researchers are planning a field experiment this summer to determine the importance of these emissions.

The new findings add to emerging evidence that plants emit substantial amounts of so-called biogenic hydrocarbons. "The biogenics are probably more important than were recognized," says Roger Atkinson of the University of California, Riverside.

The act of mowing may have its biggest impact in hay-producing areas. "When you start to crop millions of acres of alfalfa and it's drying, that could be quite a point source [of VOCs]," says biochemist Ray Fall of the University of Colorado at Boulder, who participated in the new study. Past experiments have measured some elements of smog over Indiana farmland during summer, a finding that puzzled researchers. The grass study may explain these results, says Fall. —*R.M.*

Ozone killer confounds expectations

Atmospheric concentrations of an ozone-destroying compound have risen at a surprising rate over the past decade, according to Australian scientists. These findings suggest that the protective ozone layer in Earth's stratosphere will take longer to recover than previously expected.

Measurements made in Tasmania show an increase in the concentration of halon-1211, a chemical used in fire extinguishers. Researchers had expected emissions of this compound to peak in 1988 and eventually decline, as industrialized nations phased it out in accordance with the Montreal Protocol of 1987. Since 1988, however, emissions have increased by 25 percent, estimates the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Melbourne.

Developing nations, particularly China, are most likely causing the rise in concentrations, says Paul Fraser of CSIRO. The Montreal Protocol allows developing nations to produce halon-1211 until the year 2010. According to Fraser, the additional emissions will delay the anticipated recovery of the ozone layer by up to 10 years.

Stephen A. Montzka of the National Oceanic and Atmospheric Administration in Boulder, Colo., and his colleagues have also detected increases in halon-1211 concentrations, although they calculate that emissions have remained constant. —*R.M.*

Physics

From Atlanta, Ga., at the Centennial Meeting of the American Physical Society

Quantum onions rarely blink

What is a quantum dot that doesn't blink like a quantum dot? The answer: a quantum onion.

That's what Alf Mews of the University of Mainz in Germany calls his invention, a ball of orderly arranged semiconductor atoms in nested layers.

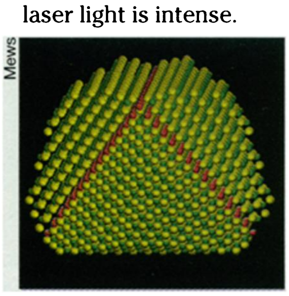
The optical properties of such onions could shed light on how electric charges become trapped in regions of semiconductors, Mews says. He also speculates that using the luminescent onions as labels for molecules might improve the accuracy of research studies, diagnostic tests, and some commercial processes.

Quantum dots, crystalline clusters of up to several thousand atoms, confine their charge-carrying electrons and the electrons' positively charged counterparts, called holes, to volumes so small that the quantum mechanical nature of those charge carriers is altered (SN: 11/23/96, p. 327).

An onion is a quantum dot with a more complex structure. Mews starts with a core of cadmium sulfide, adds a shell of mercury sulfide, then finishes with an outer layer of cadmium sulfide. The mercury sulfide layer can be as little as one atom thick.

Compared with research on regular quantum dots, "we went one step more," Mews says. With the extra layer, the researchers added an impurity that can trap charges.

Scientists have begun to investigate swapping quantum dots for dye molecules as markers that respond to laser light (SN: 10/24/98, p. 271). In the past few years, however, researchers have discovered that glowing quantum dots and dye molecules both spontaneously blink off for a tenth of a second to 10 seconds. The blinking happens more often if the laser light is intense.



Mews

By contrast, quantum onions rarely blink, Mews reports. He suspects that their layering deters charges from visiting the onion's outermost surface, where they somehow are responsible for blinking. —*P.W.*

Sliced quantum onion bares atom-thick inner layer (red).

New memories tap spin, gird for battle

After decades of running on half its cylinders, the electronics revolution will soon double its horsepower, say scientists from two electronics giants. Almost all the spectacular advances in microprocessors and computer memories to date have exploited only the charge of the electron. The electron's inherent magnetism, or spin, however, can also encode data.

Honeywell and IBM both announced on March 25 that they have built prototype spin-memory chips with speeds comparable to today's charge-based chips. Because these spin memories retain data when shut off, computers based on them will start instantly, without having to load data from disks.

Theodore Zhu of Honeywell in Plymouth, Minn., says that the company expects to offer a 1-megabit spin-based memory chip commercially this year. It will make use of a property known as giant magnetoresistance (GMR). In a conductor with GMR, applied magnetic fields markedly change electrical resistance (SN: 4/22/95, p. 245).

Work on a rival spin-memory design incorporating so-called magnetic tunneling junctions was described by Stuart S.P. Parkin of IBM in San Jose, Calif. The junctions operate more quickly than GMR circuits and can pack bits more densely, he says. GMR, however, which is already used widely in disk-drive heads, is the more mature technology. Parkin predicts that IBM will bring tunneling-junction memories to market in 3 to 5 years. —*P.W.*