Acid dew: What it does

Since Scandinavian scientists observed that acidification was killing off life in Norwegian and Swedish lakes, public scrutiny has focused on the environmental threat of acid rain. But atmospheric chemists have also been studying similar phenomena — among them acid fog, acid snow and, most recently, acid dew.

While the few previous studies on acid dew have shown that it does not rival acid rain as an environmental menace, new findings suggest that it can be harmful and that its acidification process may be more complex than was suspected. "There is a possibility that dew in fact plays a very important role in harming trees," says William L. Chameides of the Georgia Institute of Technology in Atlanta.

Acid dew forms when dewdrops absorb nitric acid and sulfur dioxide — atmospheric chemicals that mostly originate as the exhaust of automobiles and coal-burning plants. Other chemicals then oxidize the sulfur dioxide to form sulfuric acid, which along with the nitric acid increases the acidity of the dewdrop.

Although these drops are usually not harmfully acidic at night, they begin to evaporate after the sun rises, which serves to concentrate the acid in the drop. In the morning, "it's possible that these tiny acidified drops cause damage to the leaf surface," says Chameides, whose chemical study on acid dew will appear in the Oct. 20 JOURNAL OF GEOPHYSICAL RESEARCH.

Acid dew is an example of what scientists call dry deposition of trace atmospheric particles or gases. In contrast to fog or rain, which bring dissolved atmospheric chemicals to the earth, dry deposition occurs when particles or gases settle to the earth. In the case of acid dew, they happen to alight on a wet surface. According to Chameides, roughly a third of the sulfur dioxide produced in the United States reaches the ground via dry deposition.

Chameides's calculations are revealing that the mechanics of dry deposition may not be as simple as scientists had previously assumed — a finding that could have implications for emissions-control policies. Most models of dry deposition assume that "if you decrease the amount of sulfur dioxide in the atmosphere by 50 percent, you'll decrease the rate of sulfur deposition to the surface by 50 percent," says Chameides. However, his work suggests that complex chemistry could undermine a 50 percent emissions reduction so that "deposition might only decrease by 25 percent or 10 percent."

— R. Monastersky

SSC sites narrowed

The U.S. Department of Energy (DOE) has performed the first cut on the 43 site proposals for the Superconducting Super Collider (SSC), the proposed 40-trillion-electron-volt proton accelerator. Seven of the proposals, submitted on or before Sept. 2, failed to meet the DOE's most basic criteria for availability of land, power and water and for environmental impact.

All six sites proposed by private individuals or organizations failed this first cut. None of the 25 states that made submissions (some had more than one) has been ruled out. And only one site sponsored by a state government has been dropped: the International Site, straddling the U.S.-Canadian border, submitted by New York on behalf of itself and Quebec. (The DOE says it will not consider a site that is not wholly within the United States.) New York has three other submissions still in the running, however.

The survivors include 33 sites presented by state governments and three presented by municipal governments. They have been referred to a committee of the National Academy of Sciences and National Academy of Engineering, which will evaluate them in more detail and give DOE a list of the best qualified by January 1988. □

Putting the heat on new semiconductors

A blast of heat can destroy silicon-based electronic circuits. The inevitable failure of such devices at temperatures greater than 350°C has prompted researchers to look for alternative semiconducting materials that can operate at high temperatures. High-temperature devices could be used inside engines to monitor performance or for instrument packages carried by planetary probes into hostile environments. The latest candidate as a high-temperature semiconductor is the diamondlike compound cubic boron nitride.

A team of Japanese scientists, led by Osamu Mishima of the National Institute for Research in Inorganic Materials in Ibaraki, reports in the Oct. 9 SCIENCE the fabrication of a boron-nitride diode that operates at temperatures as high as 530°C. If various technical improvements are made, the researchers say, "broad application of the [cubic boron nitride] semiconductor will be possible, allowing the fabrication of special high-temperature . . . semiconductor devices."

Cubic boron nitride is a synthetic material consisting of boron and nitrogen atoms in a tetrahedral arrangement. It can be made by putting the hexagonal form of boron nitride under intense pressure. Like diamond, which is another potential candidate as a high-temperature semiconductor (SN: 8/23/86, p.118), cubic boron nitride is transparent. But unlike diamond, which is difficult to make into a semiconductor, cubic boron nitride can be made into both p- and n-type semiconductors when suitable impurities are added. A diode, consisting of adjacent n- and p-type layers, allows electric current to pass through the device in only one direction.

To create a p-n junction diode, the researchers work with materials at 55,000 times atmospheric pressure and at temperatures close to 1,700°C. The device's core is a boron-nitride crystal doped with beryllium, on top of which is slowly grown a layer of boron nitride doped with silicon. The result is a composite crystal about 1 millimeter across. It has the appearance of a tiny, boiled egg having a blue center and a translucent, yellow-orange outer layer. Slicing the egg exposes both semiconductors so that the diode can be tested. Although fashioned under high-pressure and high-temperature conditions, the device is stable at atmospheric pressure.

In principle, the researchers say, an ideal boron-nitride diode could operate at temperatures as high as 1,300°C. Even at a temperature of 530°C, their device is comparable to any high-temperature device now available. *— I. Peterson*

HLA is factor in diabetes

A genetic error that results in the substitution of a single amino acid in an immune system molecule can greatly increase one's chances of getting insulin-dependent diabetes mellitus, new research suggests. The finding supports earlier evidence that inherited forms of diabetes may result from an autoimmune response against insulin-producing islet cells in the pancreas.

John A. Todd, John I. Bell and Hugh O. McDevitt of the Stanford University School of Medicine performed detailed analysis of human leukocyte antigen (HLA) molecules in 39 diabetic patients and compared them to normal controls. HLA molecules are a critical part of the body's cell-mediated immune response and are activated in cases of autoimmunity (SN: 10/10/87, p.228).

As reported in the Oct. 14 NATURE, the researchers found that the 57th amino acid on a particular HLA protein chain was highly predictive of diabetes. Of 20 possible amino acids for that position, one, called asparagine, is most common and appears to confer protection against islet-cell autoimmunity. The presence there of any other amino acid, however, apparently alters the HLA molecule so that it is more likely to mount an autoimmune response against the insulin-producing cells. □