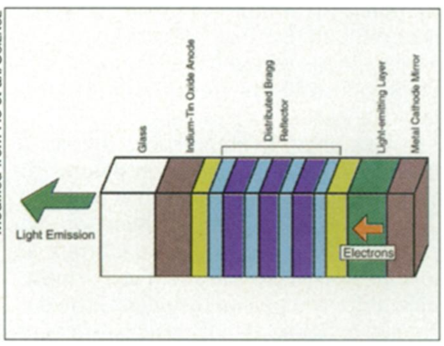
All-plastic lights for a lightweight glow

A new device takes researchers one step closer to making electronic displays completely out of plastic. A group at the University of Cambridge, England, has succeeded in replacing crucial inorganic components of a light-emitting diode (LED) with ones made out of polymers.

At the heart of the novel, almost entirely plastic device is a material called poly(p-phenylenevinylene), or PPV, which emits green light when stimulated with electricity (SN: 8/24/96, p. 119). Other polymers could, in principle, be incorporated into LEDs that glow in different colors and could be arrayed into a plastic television or computer screen.

To create the LED, the researchers sandwiched PPV between two mirrorlike layers: a thin metallic film and a layered structure called a distributed Bragg reflector. Like a butterfly's iridescent wings, this reflector bounces back a single wavelength of light while it absorbs the others (SN: 12/13/97, p. 375). Light emitted by the PPV layer reflects back and forth between the two surfaces until a single wavelength emerges from one side of the device.

Modified from Ho *et al.*/SCIENCE



A polymer light-emitting diode is built in layers. When an electric current passes between a transparent anode and the metal cathode, PPV (green) emits light that is reflected between two mirrors: a reflector (light and dark blue) and a metal film (purple). Green light of a single wavelength emerges through the glass.

The new LED, developed by Peter K.H. Ho, D. Stephen Thomas, Richard H. Friend, and Nir Tessler, emits light at a wavelength of 530 nanometers. The researchers describe their device in the July 9 SCIENCE.

A distributed Bragg reflector consists of several alternating layers of two materials with different optical properties. Light that enters the reflector bounces back and forth between the layers. Interference between the shuttling signals amplifies one wavelength but cancels out others. By tailoring the thickness and properties of the layers, the researchers can select a particular wavelength of light for the LED.

Most Bragg reflectors use two different inorganic materials. The Cambridge group used PPV not only as the light-emitting film but also in the reflector. The team blended PPV with tiny silica beads just 5 nm in diameter and then alternated layers of the composite and pure PPV.

The same coating process can lay down most of the critical components of the device. Moreover, PPV's electrical conductivity makes integrating the different components of the device much easier. The researchers have more flexibility in where they place the electrodes because electricity can travel through the reflector, Friend notes.

Organic materials have several advantages over the inorganic ones used in displays today. "It's much easier to mix and match functionalities with polymers," says Friend. Experimenters can easily tune polymers' optical and electrical properties by changing their chemical composition.

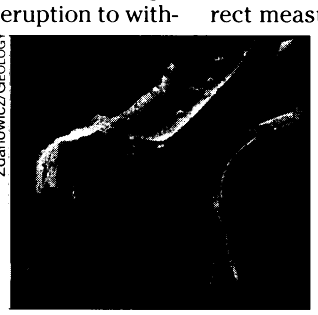
"Although further studies are clearly needed to make practical devices, this work shows much potential," William L. Barnes of the University of Exeter and Ifor D.W. Samuel of the University Durham, both in England, comment in the July 9 SCIENCE. The goal is a polymer display that is cheaper and lighter than today's products. —*C. Wu*

Quenched fire found in Greenland ice

More than 7,000 years ago, Mount Mazama in Oregon exploded out of existence. In the largest known eruption in the Cascades mountain range, this 12,000-foot peak blew its top—and much of its torso—into the sky, leaving behind Crater Lake, the deepest lake in North America. Researchers have now turned up shards from this eruption deep within the Greenland ice cap, providing clues to how the blast affected the globe.

From past studies of Mount Mazama ash found in western North America, geologists have dated the eruption to within a decade of 7,680 years ago. Christian M. Zdanowicz of the University of New Hampshire in Durham and his colleagues found volcanic debris of just that age in a core of ice extracted from the Greenland's ice sheet in the early 1990s.

Zdanowicz/GEOLOGY



Microscopic glassy shard from ancient Oregon eruption found in Greenland.

The distinct band of volcanic chemicals and ash particles was discovered in a layer of ice dated to 7,676 years ago. Moreover, analysis of the ash shards indicates that they are chemical cousins of volcanic samples taken near Crater Lake, the team reports in the July GEOLOGY.

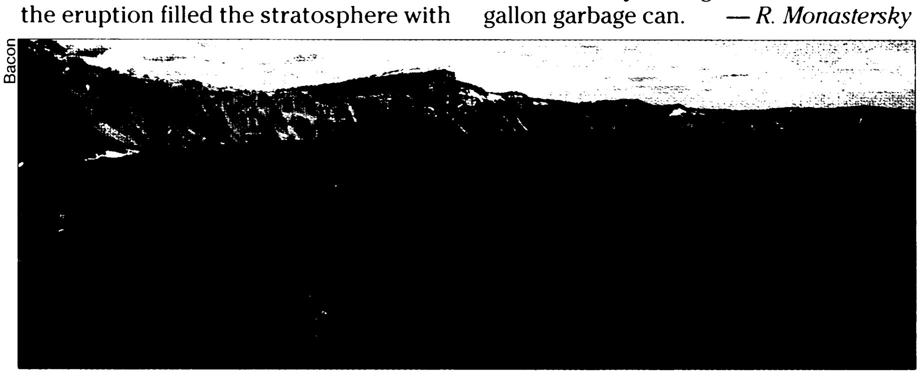
From the amount of sulfuric acid found in the ice, the researchers estimate that the eruption filled the stratosphere with 88 million to 224 million tons of sulfuric acid droplets. By blocking sunlight, the droplets would have lowered Earth's temperature by 0.6°C. The blast also shot up 8.1 million tons of chlorine that would have chewed away part of the protective ozone layer.

"It gives us an idea of what could be expected from a very large eruption along the Pacific Rim of the U.S.," says Zdanowicz.

Geologists have previously tried to estimate the atmospheric effects of the eruption, but the Greenland ice provides a direct measurement of the chemicals that drifted around the globe. "It's probably the best place to learn about that stuff," says Charles R. Bacon, a volcanologist with the U.S. Geological Survey in Menlo Park, Calif., who has studied the Mount Mazama eruption.

While the ancient blast dwarfs the 1980 shot from Mount St. Helens, Mazama doesn't hold a candle to truly giant eruptions. When Bacon compares Mount Mazama to the volume of a half-gallon milk carton, the Mount St. Helens blast would fill half of a small espresso cup and the 1991 eruption of Mount Pinatubo would equal a 6-ounce coffee cup. A giant eruption, like one that occurred in Yellowstone National Park 600,000 years ago, would stuff a 30-gallon garbage can. — *R. Monastersky*

Bacon



Born in a blast, Crater Lake measures almost 6 miles across.