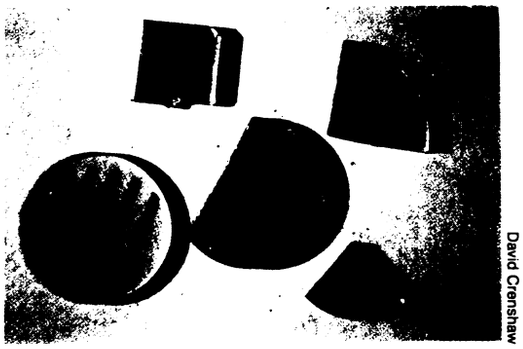
Colored glass lights future optics route



David Crenshaw

Colored glasses made by embedding gold in fused silica (red and red-striped), gold in sapphire (purple), and copper in fused silica (orange and gray).

Thousands of years ago, craftsmen made glasses in vibrant gold, red, and blue hues by mixing metal dusts into fire-melted sand. The ancients followed "magic" recipes to produce these decorative materials.

Now, with better formulas and more modern tools at hand, scientists are rediscovering colored glasses – as promising materials for use in optical computers and light-based electronics. Using a technique called ion implantation to embed metal ions in glassy and crystalline substrates, a group of scientists led by Richard F. Haglund Jr. of Vanderbilt University in Nashville can precisely engineer colored glasses to control the transmission of light.

"These composite materials could function as the nonlinear element in an all-optical circuit," Haglund told SCIENCE NEWS.

To build ultra-fast electronics that use photons instead of electrons, two types of light-conducting materials must be developed: those that focus and speed traveling light beams and others that act as switches, allowing only certain kinds of light to pass (SN: 6/22/91, p.389).

Colored glasses could potentially perform the latter, "logical" function, says Haglund. They gain their "intelligence" by combining the optical properties of transparent glass and opaque metals. "Some light goes all the way through the glass," he explains, "but light absorbed by metal clusters is captured temporarily and then re-radiated."

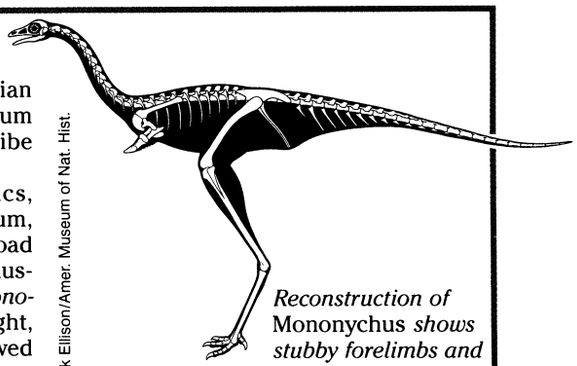
With ion implantation – commonly used in the semiconductor industry to etch silicon chips – the group can manipulate the size, density, and geometry of the nanometer-size metal clusters that form in the glass. This control could not have been achieved using the old chemical methods for making glasses because of the limitations of chemical thermodynamics, he says.

Using an ion implantation device, the researchers shoot an accelerated stream of metal ions back and forth across a surface. So far, the team has tried embedding gold, copper, silver, lead, erbium, bismuth, and platinum into silica and silicate glasses, lithium niobate, and sapphire crystals. Haglund and his coworkers at Oak Ridge (Tenn.) National Laboratory and the City College of New York report their findings on the optical properties of silica implanted with gold in the April 12 APPLIED PHYSICS LETTERS.

"It's possible these metal-nanocluster composite materials could be effectively integrated into a future fiber-optic system," comments Peter W.E. Smith, executive director of the Ontario Laser and Lightwave Research Center at the University of Toronto. If these glasses show few of the detrimental thermal effects that plague some optical materials, they could be used in fast optical switching devices that route signals in a communications network, Smith says.

The next challenge for Haglund's group will be to design a composite that can split a light beam for use in a wave-guide device. *– K.F. Schmidt*

A clawed wonder unearthed in Mongolia



Mick Ellison/Amer. Museum of Nat. Hist.

Reconstruction of Mononychus *shows stubby forelimbs and long legs.*

Mongolian and U.S. researchers have found a 75-million-year-old, bird-like creature with a hand so strange it has left paleontologists grasping for an explanation.

Called *Mononychus,* such fossil specimens display several anatomical features characteristic of avians, leading the discoverers to classify the animal as an early bird. While other researchers question whether to perch *Mononychus* in the same family tree as birds, paleontologists agree this creature had a bizarre set of front limbs. *Mononychus* had stubby powerful arms that each ended in a large single claw, which the animal might have used for digging. But that arrangement seems at odds with its long legs, apparently built for running.

"This is one of the most unusual things that I have ever seen," says one of its discoverers, Mark A. Norell of the American Museum of Natural History in New York City.

Paleontologists from the Mongolian Museum of Natural History in Ulan Bator unearthed the first specimen of *Mononychus* in 1987. Last year, in a joint project, researchers from the two museums discovered two additional specimens during an expedition. Later, a fourth fossil turned up among bones collected in 1922 during a Mongolian expedition by other American Museum researchers. Norell and others describe the animal in the April 15 NATURE.

Among its avian characteristics, *Mononychus* had a keeled sternum, which in modern birds provides a broad surface for anchoring the flight muscles. But the tiny forelimbs of *Mononychus* would not have permitted flight, Norell says. *Mononychus* also showed other important avian developments, such as a bird-like pelvis and a shrunken fibula, also common to modern avian species.

The researchers say the *Mononychus* specimens are particularly important because the bones were preserved without being crushed. In most fossils of early birds, the delicate bones have been flattened by overlying sediments. The *Mononychus* finds provide a three-dimensional representation for paleontologists to study.

Norell and his colleagues have raised two possible theories to explain the relationship between this animal and all birds, including the 147-million-year-old *Archaeopteryx,* the earliest known bird. In one scenario, the new-found animal belongs to a lineage of flying birds that had lost that ability by the time of *Mononychus.* In the other possible interpretation, *Mononychus* represents the relict of a bird line that never flew. In this case, flight must have evolved first with ancestors of *Archaeopteryx* and then, independently, among the forebears of modern birds.

While other paleontologists hail the new discovery, they remain unconvinced that *Mononychus* fits in the same phylogenetic category as *Archaeopteryx* and all later birds. Paul Sereno of the University of Chicago notes that *Mononychus* had arms built much like those of digging animals. Because moles and other diggers have keeled sternums and wrists reminiscent of birds, the classification of *Mononychus* becomes difficult, he says. *– R. Monastersky*