# Shine on, shine on LED, for better displays

The science fiction image of a gigantic, flat television screen hanging on a living room wall has loomed large in Hollywood movies. It's still just a pipe dream, but researchers in Britain, working on a luminescent plastic diode, have now taken the first few steps toward making that vision tangible.

Physicist Neil C. Greenham and chemist Stephen C. Moratti, both at the University of Cambridge in England, have produced a light-generating polymer with high enough efficiency to be useful as a light-emitting diode (LED). Conventional semiconductor LEDs, made mostly of inorganic materials, are now widely used in the displays of electronic equipment, from digital watches to control panels in autos, aircraft, and computers. The new plastic light sources reportedly work as well as most LEDs now in use and may soon surpass them in efficiency. Though still in the research phase, the polymer LED may eventually permit enhanced color displays for computer notebooks and perhaps large, flat-screened monitors.

The researchers report their results in the Oct. 14 NATURE.

Three years ago, physicist Richard H. Friend and chemist Andrew B. Holmes, both at Cambridge and coauthors of the current report, and their colleagues first reported polymer electroluminescence, but with impractically low efficiencies.

By March 1992, using a material called poly (*p*-phenylene vinylene), or PPV, Friend and Holmes had made the efficiency 30 times greater, yet it was still below that of existing LED technologies (SN: 3/14/92, p.164).

Now they report efficiencies above those of current LEDs from a new family of materials called poly(cyanoterephthalylidene)s. "By efficiency, we mean the number of photons emitted versus electrons injected," says Friend. "Crudely put," adds Holmes, "for every 100 electrons you inject into the material, 4 photons pop out."

Thus, the new polymer has an efficiency of 4 percent, with a theoretical limit of 25 percent, says Holmes. In comparison, typical inorganic LEDs operate at efficiencies of 1 to 2 percent, he says. (A tungsten lightbulb reaches 10 percent.) "In terms of efficiency, we're now very good," says Friend. "We've come up by a factor of 400 since 1990. This new cyano polymer is now competitive with most other LED technologies for display applications."

The "semiconducting conjugated polymer" emits light when positive and negative charges, supplied by electrodes on opposite sides of the thin plastic film, meet on the same bit of polymer chain. "Their meeting causes an excited state in the chain, which emits a photon in the visible wavelength," Holmes explains.

The key to raising the new polymer's efficiency was improving its ability to accept negative charges, Holmes says. The researchers sandwiched PPV in between layers of the new cyano polymer to help charge transport, and they replaced troublesome calcium cathodes with simpler aluminum ones, further improving the film's operation.

By altering the polymer's physical makeup slightly, chemists can change the colors it emits, "almost as if it were a dye," says Holmes. "We've got a way to tune the wavelength, or color, of the light emitted by altering the shapes and positions of the polymer's building blocks. We should be able to produce all of the primary colors and improve color purity."

Lest onlookers envision a road to the future paved in glowing plastic, both Holmes and Friend caution that there is still a long way to go, with no applications readily at hand. "But," adds Holmes, "there really are enormous possibilities here."

Examples include light-emitting clothing for police or rescue workers, glowing tools, radiating vehicles — perhaps even the proverbial wall-size flat television to hang like a painting in the parlor. "Flat-screened TVs and better computer displays are what we're all after here," Holmes confesses, "a sort of LED Holy Grail." — *R. Lipkin*

# Exercise may help to keep arteries springy

Regular aerobic workouts may do more than keep the body trim and supple: A new study suggests that such a routine may keep the blood vessels flexible. That finding holds out the hope that people can ward off age-associated high blood pressure — although not without plenty of sweat.

Noticeable signs of aging, such as wrinkles and gray hair, are accompanied by less visible changes, such as the progressive stiffening of the arteries. The tubes we call arteries meet the body's ever-changing demand for nourishing blood by dilating and constricting, a process that requires a stretchy vessel wall. Even among healthy people, the flexibility of the arteries starts to decline with age. So-called hardening of the arteries occurs in part because a key protein called elastin is replaced with a less elastic building material.

Hardening of the arteries had been thought of as an immutable part of the aging process. Researcher Edward G. Lakatta of the National Institute on Aging's Gerontology Research Center in Baltimore, Md., and his colleagues now have evidence that challenges that dogma. Their findings suggest that fitness training may delay that age-associated arterial stiffness.

"If the findings are true, it indicates that as you get older, you should continue to exercise," comments coauthor Frank C.P. Yin of Johns Hopkins University School of Medicine in Baltimore.

The study's results could have broad public health implications, Yin adds. If the arteries stay supple, older people may be able to escape the damage to the heart that occurs when it forces blood through unyielding arteries, he says.

The team first looked at 146 healthy male and female volunteers age 21 to 96. None of the volunteers smoked cigarettes or engaged in regular aerobic exercise, defined as 20 minutes of rigorous activity three times a week.

The researchers then used two noninvasive methods to measure and record each volunteer's "arterial stiffness index" while at rest. Next, the team instructed the recruits to exercise to exhaustion on a treadmill.

The researchers confirmed the notion that stiffening of the arteries occurs in varying degrees as people get older, even among those with normal blood pressure readings. However, arterial inflexibility appeared inversely related to each recruit's fitness: The more fit volunteers had arteries that were more bendable than their couch-potato peers. That finding held true even when the team controlled for age.

The team wondered whether they would see a more dramatic example of this relationship if they looked at a group of senior athletes. Thus, they recruited 14 men age 54 to 75 who jogged about 30 miles per week.

These athletes didn't completely escape the ravages of aging. However, the researchers found that they had about 30 percent less vessel stiffness than their age-matched sedentary peers. The team describes its findings in the October CIRCULATION.

Intense aerobic activity may actually stave off aging-associated hardening of the arteries, a problem that can strike well before overt high blood pressure is diagnosed, Lakatta says. Still, this study can't prove a cause-and-effect relationship between exercise and youthful blood vessels, he adds. Furthermore, the team has yet to show that moderate exercise — a more attainable goal for most Americans — would also provide arterial benefits.

An alternative explanation for the findings is that certain people are genetically predisposed to springy blood vessels. Even if genes do play a role, the researchers believe that lifestyle factors — such as exercise or the amount of salt in the diet — may also affect this silent aging of the arteries. — *K.A. Fackelmann*