Scientists at the University of Alabama and a New Jersey-based company have developed a prototype device that directly measures the amount of oxygen reaching the brain.

The instrument could give doctors critical information on the health of a patient who has suffered a severe physical trauma—before the conventional vital signs show any significant change.

After a heart attack or serious injury, doctors check the supply of oxygen to the brain by measuring the patient’s pulse and blood pressure.

But readings of these vital signs can be misleading. A patient with severe internal bleeding will not show any drop in blood pressure until one-third of the body’s blood has been lost, for example. The oximeter could reveal a life-threatening problem hours earlier, the researchers say.

The four-laser spectroscopic oximeter measures the oxygen saturation in retinal blood vessels, which share blood circulation with the brain. A measurement can be performed in one second.

With the University of Alabama scientists, Sarnoff Corporation has set up a joint venture, VitalCare Diagnostics, to develop the device, which could also be used in diabetic retinopathy, stroke screening, glaucoma, and hypertension monitoring.

“The eyes are not just a window to the soul, they offer a looking-glass into the brain,” said Chris Gregory, head of biomedical devices at Sarnoff.

Gregory said the four lasers are needed to determine four parameters—oxygen saturation, hemoglobin concentration, blood vessel diameter, and a scattering coefficient.

Three wavelengths—635 nm, 670 nm, and 830 nm—are currently provided by diode sources, with the fourth, a 488 nm emission, supplied by a small argon ion laser.

“The four wavelengths enable us to create a sufficiently accurate spectrum to calibrate the oxygen saturation,” Gregory said, adding that the argon ion laser will be replaced with a compact diode-pumped source in the eventual product.

Clinical trials of a prototype are expected to begin in about a year. A device could be available commercially in 2004.

Advances in Lithography

Officials at Corning Tropel say the company has manufactured a lithographic objective lens with a record-breaking resolution.

With a numerical aperture (NA) of 0.85 and the ability to transmit short-wavelength ultraviolet light, the lens is said to resolve features smaller than 70 nm, thus meeting the requirements for next-generation lithography.

“The linewidths on today’s most advanced microchips are 130 nm,” said Corning Tropel President and Chief Executive Officer John Bruning. “This lens is capable of resolving features nearly half that size.”

The UK-based laser microprocessing specialist Exitech has integrated the lens into its 157-nm lithography system.

“This lens has the highest NA and shortest wavelength of operation of any objective lens used for high-resolution lithographic imaging,” said Malcolm Gower, technical director at Exitech.

“It will enable researchers to develop the technologies required for manufacturing the circuits on future generations of silicon chips.”

Semiconductor Leading Edge Technologies (SELETE), a consortium of Japanese semiconductor manufacturers, has used Exitech’s 157-nm lithography system to image features as small as 50 nm on silicon wafers.
Researchers at the Philips Center for Industrial Technology have developed a compact, optical interface for portable electronic equipment. The team says the device can be easily integrated into cell phones, laptop computers, and personal digital assistants (PDAs), where it can serve as a space-efficient alternative to a mechanical trackball or touch-pad.

Traditional interface solutions, such as mechanical switches and touch screens, are not ideal because they either consume too much space or are too expensive. The Philips researchers say their optical scrolling device has none of these disadvantages.

The device consists of a low-power red laser diode and a detector placed beneath a lens. Light from the 650-nm laser is focused on an object, such as a fingertip, creating an external cavity. It is not necessary to touch the lens.

A small portion of this light is then reflected back and mixes with the light within the internal laser cavity. "Our scrolling device is based on this so-called laser self-mixing technique," said Philips researcher Ren Duijvé.

"Light emitted by the diode laser re-enters the cavity and affects its gain and frequency. This self-mixing effect can be used to measure the velocity or position of objects."

According to Duijvé, the design works well with surfaces ranging from human skin to paper and even black cardboard. Duijvé and colleagues have integrated a prototype device that recognizes up and down movements and clicks into a cell phone.

"The demonstrators were sized some 15 × 10 × 8 mm³," Duijvé said.

Within Philips, technology is available to integrate the device down to a few cubic millimeters, Duijvé said. A version using three lasers for up-down, left-right, and clicking functions is now being prototyped. It uses a technique called laser self-mixing range finding, in which the self-mixing signal is used to determine the distance between the laser and the external object.

"Our research opens up new opportunities for contactless measurement of speed and distance," Duijvé said.

The team has several patents pending and is currently working with several other parties to commercialize the device. Laser scrolling was developed especially for compact equipment such as mobile telephones, laptop computers, and personal digital assistants. In prototypes, researchers integrate a display and a laser scroll switch inside the housing of a mobile phone. The device works when the user moves his/her finger over the scrolling device and pulses are generated that are proportional to the object speed and direction (center). In the current setup (right), the researchers say that velocities up to 150 mm/s can be measured.

Scientists in Spain have found that an organic molecule commonly used in LED production could offer a cheap and easy route to blue diode lasers.

María Díaz García and colleagues at the University of Alicante observed gain from the TPD molecule after pumping it with a 355-nm frequency-tripled Nd:YAG laser.

Although further research is needed to see whether the material can exhibit lasing properties, García said that it should be possible to electrically pump TPD because it is a semiconductor.

"TPD is a very good candidate for making blue-emitting diode lasers," García said. "Emission is centered around 420 nm, but this could be adapted easily by subtly altering the chemistry of the molecule, she said.

TPD is widely available because it is already used as a hole-transporting layer in LEDs. The film that showed gain was made by a simple spin-coating technique, which the researchers say would be far cheaper to implement than the epitaxial deposition techniques used to make inorganic diode lasers.

The scientists are doing follow-up work centered on making TPD lase by placing it inside a cavity. García is also researching the possibility of electrical pumping, as well as whether diodes or a lamp can replace the pump laser.