MATERIALS SCIENCE

From New Phosphor, a Double Crop of Photons

Cheap, efficient, and cool, fluorescent tubes are so common that it is hard to imagine a public or office building without them. But they are not ideal. They contain mercury, which is poisonous and has to vaporize each time the power goes on, resulting in a lag that keeps them from being used as brake lights for cars and in fax and photocopy machines. In this issue, a team of Dutch researchers reports a step toward a better fluorescent tube, which could end up making these lights even more ubiquitous.

Replacing the mercury inside the tubes with a noble gas like xenon would eliminate the hazard and speed start-up. The stumbling block is the phosphor: the coating that absorbs ultraviolet (UV) light given off by the vapor inside the tube and reemits white light. Although current phosphors absorb UV photons from the mercury and reemit them as visible photons with about 90% efficiency, that's not good enough for xenon. Xenon generates UV photons at much higher energies than mercury, so one-to-one conversion to low-energy visible photons means that much of the energy going into the xenon is wasted as heat. For practical xenon tubes, "it became necessary to develop phosphors that give more than one [visible] photon for every absorbed UV photon," says Alok Srivastava, a chemist at General Electric in New York. On page 663, chemist Andries Meijerink and his colleagues at Utrecht University in the Netherlands report an experimental phosphor that does just that.

The quest for a photon-doubling phosphor started almost 30 years ago. Researchers began looking for the effect in materials containing lanthanides—the heavy elements that are a standard ingredient in ordinary phosphors. Some early formulations did manage the two-for-one conversion, but they emitted lots of ultraviolet or infrared photons, and not enough visible light. "By the 1990s, people gave up," says Meijerink.

Meijerink, however, was one of the few who persisted, studying how lanthanide ions lose energy after UV light has excited their electrons to high energy levels. He hoped to find that a lanthanide boosted to a high energy level could, say, lose energy in two steps, emitting a visible photon each time. But it turned out, he says, "that using only one ion would never work." Then Meijerink's colleague Harry Donker thought of distributing the energy from each absorbed UV photon between two different types of lanthanide ions.

Meijerink and his colleagues tested a pair of lanthanides, gadolinium and europium, in the form of crystals of lithium gadolinium fluoride, doped with europium. They bombarded the crystals with high-energy UV photons, which bumped the gadolinium into an excited state. The gadolinium got rid of its excess energy by transferring it to two nearby europium ions through a complex interaction of electric fields. The europium ions in turn shed the energy by each emitting a single red photon, giving a total of two red photons emitted for each UV photon.

To make sure that each UV photon really was generating two red photons, the researchers bombarded the crystals with two different levels of UV radiation, one energetic enough to drive the two-step process, the other able only to drive a one-step process that produced just one red photon. The red fluorescence sparked by the higher energy UV was twice as intense, indicating that double the number of photons was being emitted.

Because plain red light isn't useful in most settings, Meijerink now wants to hunt for other phosphors that will use the same principle to emit green and blue photons, which in combination with red photons would yield white light. He also needs to find a way to make his phosphor absorb more UV photons, so that it can emit brighter light. "There are engineering issues, like sample purity and stability, that have to be addressed," says Kevin Bray, a chemist at Washington State University in Pullman, "but they have shown that it is possible to take a high-energy UV photon and extract from it two visible photons. That is very promising." Srivastava agrees: "This is the first experiment to demonstrate that you can get a practical system out of these ideas." —MEHER ANTIA

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CLONING

Report Casts Doubt on Korean Experiment

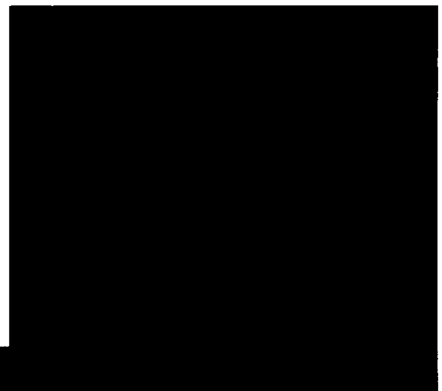
SEOUL, KOREA—One month after Korean fertility specialists declared that they had cloned a human embryo, the Korea Medical Association (KMA) has issued a report casting serious doubt on the claim. Even without evidence of success, however, the experiment has prompted calls for stricter government regulation of such research and closer university oversight of its faculty.

The 10-page report, presented this week, was written by a four-member panel convened by the medical association to investigate press reports of work done in early December by researchers at Kyunghee University Hospital here (*Science*, 1 January, p. 16). The team said it transferred the nucleus of a somatic cell into an egg cell whose nuclear material had been removed. Both cells were donated by the same patient. The reconstituted egg cell then divided twice before the researchers discarded it and ended the experiment.

The KMA report questions whether the nuclear transfer was done properly, if at all, and whether the DNA from the transplanted cell or the egg cell was driving the division of the new cell. It noted that the decision to take both cells from the same woman, a patient in the hospital's fertility clinic, makes the results extremely hard to interpret. "They insist they did this. But I don't know," says biochemist Seo Chung Sun of Seoul National University, who headed the investigation.

The KMA report notes that, instead of fixing the four cells on a microscope slide for future reference, the researchers simply threw them away. They also did not culture and save the somatic (cumulus) cells, a kind of cell that surrounds the oocyte, from which the DNA was transplanted. "We don't have any material to judge. That's a big problem," says Seo.

The Kyunghee team says they did not retain material from the experiment because they never intended to prove anything. Referring to a cloning technique used on mice (*Nature*, 23 July 1998, p. 369), team member Lee Bo Yeon says the work was done "to confirm if the Hawaii technique was possible in this lab." A press release that generated international news coverage was intended only to inform other scientists interested in the technique, Lee explains.



Visible proof? Lee Bo Yeon and colleagues at Kyunghee University say they produced the cell shown above by transplanting human DNA from an adult cell into an enucleated egg.

CREDITS: (BOTTOM, LEFT TO RIGHT) MICHAEL BAKER; KYUNGHEE UNIVERSITY