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CHEMICAL SENSORS

RED SIGNALS LEAD

DNAzyme-nanoparticle sensor could be basis of home lead-paint detector

STU BORMAN

A sensitive and selective colorimetric sensor for lead may at last provide a simple test for lead in paint [*J. Am. Chem. Soc.*, **125**, 6642 (2003)]. The new type of sensor, developed by chemists at the University of Illinois, Urbana-Champaign, may also be useful for detecting and measuring other metals, nonmetals, and compounds for applications such as household and environmental monitoring, developmental biology, and clinical toxicology.

LEAD SLEUTH
Lu with colorimetric Pb sensor developed by his group.
PHOTO BY BILL WIEGAND/ UNIVERSITY OF ILLINOIS

Lead in paint is a hazardous neurotoxin, but no simple, inexpensive, and reliable means has been available to test for it. The colorimetric lead-paint test kits available have been found to give "high rates of false-positive and false-negative results," says Illinois associate professor of chemistry and biochemistry Yi Lu. He believes the sensor that he and graduate student Juewen Liu developed can overcome these shortcomings and could lead to "a simple leaded-paint test kit, similar to pH papers."

"This is a really exciting and beautiful piece of work," comments associate professor of chemistry Hilary A. Godwin of Northwestern University, a specialist in lead chemistry and detection. The sensor "offers a simple, colorimetric alternative to current methods for monitoring lead in paint in housing--colorimetric tests and X-ray fluorescence spectroscopy. The former is not very reliable, and the latter requires expensive instrumentation and a trained and certified lead inspector. As with any technology, it will be important to validate the reliability, robustness, and reproducibility of the test before taking it to market."

Key to the new sensor are gold nanoparticles and a DNAzyme that catalyzes cleavage of a substrate DNA only when activated by lead. The DNAzyme, DNA substrate, and DNA-functionalized gold nanoparticles combine to form a blue aggregate. In the presence of lead, the substrate is cleaved, aggregate formation is inhibited, and the more highly separated nanoparticles appear red. The intensity of the red color indicates the amount of lead present. Detection ranges can be tuned by adding different amounts of an inactive DNAzyme. And sensors for other analytes can be made with DNAzymes activated by other substances.

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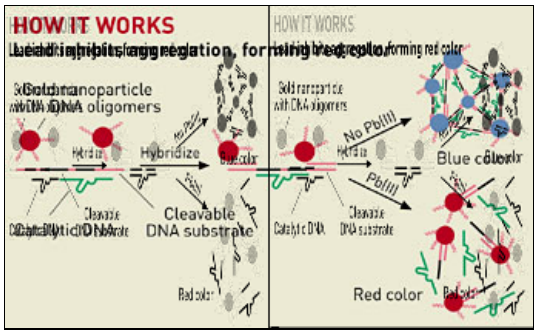
The sensors are based in part on pioneering work by Northwestern University chemistry professor Chad A. Mirkin and coworkers in the mid-1990s on the use of DNA-functionalized gold nanoparticles for detection of DNA. The new study, Mirkin comments, "expands the scope of nanoparticle detection to a very large number of analytes--and lead, in particular, is a very important one. The chemistry and engineering communities are very interested in what nanotech is of- fering in terms of utility. This is a beautiful example."



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