

the absorbing energy state integrated over the absorption path length. Since measurement is of decay time rather than intensity, the sensitivity is not affected by pulse-to-pulse fluctuations. It is instead determined by the number of reflections in the cavity, so the mirrors require a high reflectivity.

If the flame contains a high concentration of an absorbent material, such as OH, the intensity of the laser light rapidly decreases. If the concentration of the intermediate product is small, as for CH and CH<sub>2</sub>, less laser light will be absorbed. The level of absorption and the rate at which it occurs are measures of the quantity of that combustion gas in the flame. Each combustion product is sensitive to a particular wavelength of the laser light, so a different laser is used for each substance.

Evertsen found that CRDS could measure HCO concentrations of 430 parts per million (ppm) and CH<sub>2</sub> concentrations of 80 ppm. The toxic gases NO and NO<sub>2</sub>, which are difficult to measure using other techniques, could be detected at concentrations of 25 ppm and 3 ppm, respectively. CH molecules could be detected at concentrations of just a few ppb.

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## References

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- [2] R. Evertsen, PhD Thesis, University of Nijmegen, The Netherlands, 2002.

## Chemosensors on the way for lethal marine toxin

Florida-based scientists are close to developing chemosensors for saxitoxin (STX), which is among the metabolites produced by red algal blooms and which can fatally poison humans who eat tainted shellfish.

Robert Galway of the University of Miami and colleagues from there and Eckerd College synthesized and evaluated 11 anthracylmethyl crown ethers

as fluorescence sensors for STX [1]. They found that their fluorescent enhancement data were consistent with 1:1 binding complex for all crowns.

The current benchmark method for detecting STX and its congeners in shellfish is the mouse bioassay, which has a detection limit of 40 µg of STX/100g of shellfish. In the AOAC (Association of Official Analytical Chemists) technique, extraction of shellfish that contain 40 µg of STX/100g results in an aqueous solution of  $\sim 10^{-6}$  M in STX, which is injected into the mouse.

At present, the crown-ether sensors show excellent fluorescence enhancement at STX concentrations of  $10^{-4}$  M, with many showing 10–20% enhancement at STX concentrations of  $5 \times 10^{-6}$  M. As this is close to the limit of detection of the mouse bioassay, it is seen as very encouraging for the development of the better sensors needed for STX monitoring of environmental samples.

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## Reference

- [1] R.E. Gawley, S. Pinet, C.M. Cardona, P.K. Datta, T. Ren, W.C. Guida, J. Nydick, R.M. Leblanc, *J. Am. Chem. Soc.* 124 (2002) 13448.

## IR reflectography brings to light Old Masters

The National Gallery in London is mounting an exceptional exhibition of some 20 previously unseen Old Masters — comprising original preliminary drawings that artists such as Bruegel and Raphael made in the course of executing their paintings.

The technique of infrared reflectography has revealed underdrawings in important Renaissance paintings from Italy, Germany and The Netherlands. These include Pieter Bruegel the Elder's *The Adoration of the Kings*, Raphael's *The Procession to Calvary*, Jacopo Pontormo's *Joseph with Jacob in Egypt*, Albrecht Altdorfer's *Christ taking Leave of his Mother* and works by Carlo Crivelli, Hans Memling, Giorgione, Lucas Cranach and Stefan Lochner. The pre-

liminary drawings are themselves revealed to be extraordinary feats of Renaissance draughtsmanship.

The Gallery has played a leading role in developing IR reflectography, which is based on recordings of IR images of carbon-rich materials, such as charcoal, that the artists used to sketch their initial ideas. This is possible because the paint layers are transparent to near IR radiation. These areas look dark when viewed in reflected light. Through computer analysis of a reflectogram, the drawing made by the artist on the ground layer (known as the underdrawing) can be revealed.

The catalogue accompanying the exhibition includes essays on the role of underdrawing in the painters' workshops, and on the materials and techniques employed, which are followed by individual entries on the underdrawings in paintings.

In some cases, analysis of the reflectogram revealed significant differences between the underdrawing and its final version, or *pentimenti*, and even sketches of objects without any relation to the painting as it is seen today. For example, Italian artist Jacopo Pontormo painted *Joseph with Jacob in Egypt* with the deathbed scene in the top right-hand corner, while the underdrawing revealed by IR reflectography shows that he first drew the deathbed scene top-left of the centre in the background (see Figure opposite).

Running until 16 February 2003, the exhibition is sponsored by GlaxoSmith-Kline, which has also contributed to ongoing research into the Gallery's collection by making a significant donation of scientific equipment.

## Reference

- [1] D. Bomford, (Ed.), *Art in the making: underdrawings in renaissance paintings*, NGC, London, 2002, £19.95 (<http://www.nationalgallery.org.uk/>).

## Lipoproteins identify risk of second heart attack

Measuring the numbers of "bad" lipoprotein particles (LDL) and "good" lipoprotein particles (HDL) in blood gives a much better indication than LDL and HDL cholesterol measurements of the risk of a patient with coronary heart disease (CHD) experiencing a second fatal