Integrated Optical Immunofluorescence Sensor for Environmental Monitoring

R.D. Harris*[1], G.R. Quigley[1], J.S. Wilkinson[1], A. Klotz[2], C. Barzen[2], A. Brecht[2], G. Gauglitz[2] and R.A. Abuknesha[3]
1 Optoelectronics Research Centre, Southampton University, UK
2 Institut für Physikalische und Theoretische Chemie, Eberhard-Karls-Universität, Tübingen, Germany
3 GEC-Marconi Materials Technology Ltd., Borehamwood, UK

We have demonstrated a regenerable waveguide fluorescence sensor for environmental monitoring. Characterisation of the sensor as a detector of the pesticide 2,4 dichlorophenoxyacetic acid in water is presented. A binding inhibition assay, using fluorescent Cy5.5 dye-labelled antibodies, was monitored at the modified surface of the glass waveguide to detect the target analyte. Incorporation of a thin high-index film at the waveguide surface enhanced device sensitivity.

Fluorescence from the dye-labelled antibodies bound to the sensor surface was excited by a He-Ne laser end-fire coupled into the waveguide, collected from an area of 0.02 mm^2 by an optical fibre located under the sensor chip and detected by a silicon photodiode. Due to photobleaching of the dye molecules the fluorescence was only excited after antibody binding. The signal was evaluated as the difference between the fluorescence signal integrated for 100 s after binding and the background signal similarly integrated before binding. After each assay the surface of the transducer was regenerated for immediate reuse.

The average of three calibration curves is plotted in figure 1. The curve has a mid-point of 0.68 ppb and a calculated detection limit of 0.28 ppb. A 20 nm thick tantalum pentoxide film on the waveguide surface increased the peak fluorescence by a factor of approximately 8 compared with an uncoated sensor. The implications of the use of thin high-index films on sensor performance, techniques for reducing photobleaching and sensor array implementation will be discussed.

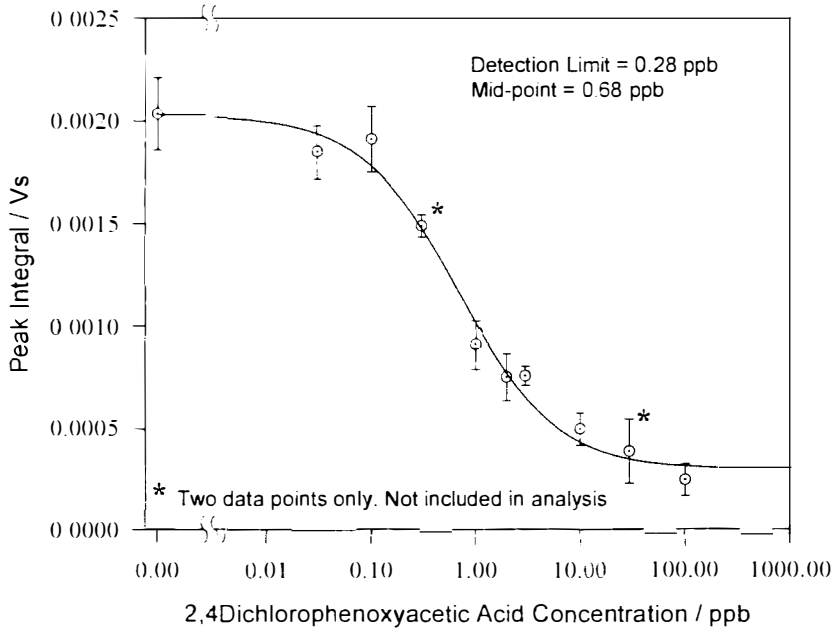

Fig.1 *Averaged calibration curves*