Optical devices for biomedical applications

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Abstract

Optical techniques offer a powerful tool for both medical and biological applications. Many of these devices can achieve results without requiring biochemical reactions. Devices can use absorption, reflection, luminescence or fluorescence.
Waveguides can use absorption in an evanescent wave, using a coating layer on the surface. Coating layers can be used which trap specific bacteria. The absorption increases with increasing levels of trapped bacteria. Oxygen saturation is measured through the absorption of two wavelengths. This simple technique is widely used in medical applications and can also be miniaturised to be integrated into catheter. Emission of light, whether through fluorescence or luminescence is also widely used in measurements. Markers can be used to attach to the cells which emit light when illuminated. Impregnated polymers can be used to generate fluorescence which is controlled by the element of interest. An example of the is an oxygen sensor. This device measures oxygen partial pressure and can be applied to blood and tissue. It is also suitable for implantation. Parameter such as blood sugar can also be measured optically. Most of these devices require optical activation, but this can be achieved using LEDs integrated into the device.
Optical techniques can be used to measure a wide range of body parameters and also bacteria and viruses. This paper will present the different optical approaches, and the types of structures which can be made. A description will also be given for the fabrication technologies and finally examples will be given of devices for the different application.

Short Bio

Paddy French received his B.Sc. in mathematics and M.Sc. in electronics from Southampton University, UK, in 1981 and 1982, respectively. In 1986 he obtained his Ph.D., also from Southampton University, which was a study of the piezoresistive effect in polysilicon. After 18 months as a post-doc at Delft University, The Netherlands, he moved to Japan in 1988. For 3 years he worked on sensors for automotives at the Central Engineering Laboratories of Nissan Motor Company. He returned to Delft University in May 1991 and is now a staff member of the Laboratory for Electronic Instrumentation In 1999 he was awarded the Antoni van Leeuwenhoek chair and in June 2002 he became head of the Electronic Instrumentation Laboratory. He is Editor-in-chief of Sensors and Actuators A and General Editor of Sensors and Actuators A&B. His research interests are integrated sensor systems, in particular for medical applications