Advanced Biosensors

ORNL's Advanced Biomedical Science and Technology Group has developed various biosensors that combine laser excitation, fiberoptics probes and biological recognition elements into integrated devices for ultra-sensitive and selective detection of chemical, biological species in complex environmental and biomedical samples.

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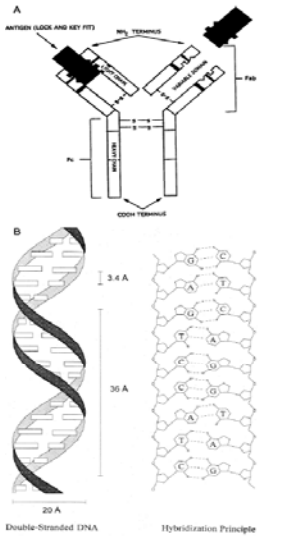
Technical Concept



A biosensor is a special type of sensor often used in bioanalysis. Biosensors can be classified either by their bioreceptor or their transducer type. A bioreceptor is a biological molecular species (e.g., an antibody, an enzyme, a protein, or a nucleic acid) or a living biological system (e.g., cells, tissue, or whole organisms) that utilizes a biochemical mechanism for recognition.

Bioreceptors are the key to specificity for biosensor technologies. They are responsible for binding the analyte of interest to the sensor for the measurement. These bioreceptors can take many forms, and the different bioreceptors that have been used are as numerous as the different analytes that have been monitored using biosensors. However, bioreceptors can generally be classified into five different major categories: (1) antibody/antigen, (2) enzymes, (3) nucleic acids/DNA, (4) cellular structures/cells, and (5) biomimetic. Figure 1 shows a schematic diagram of two types of bioreceptors: the structure of an immunoglobulin G (IgG) antibody molecule, and DNA and the principle of base pairing in hybridization.

Development Approach

For environmental sensing and medical diagnostic applications, there is a strong need for a truly integrated biosensor systems that are sensitive and selective and can be easily operated by unskilled personnel. Some of the currently commercially available technologies have demonstrated their usefulness, but they are laboratory-oriented and involve relatively expensive equipment and trained, supervised operation. For practical environmental monitoring, health protection, and medical applications, the development of low cost, rugged and practical biosensors that can be used in the field can be a major driving force for the expansion of optical biosensor technologies.

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