Handheld DNA detector

March 10 2008

A researcher at the National University at San Diego has taken a mathematical approach to a biological problem - how to design a portable DNA detector. Writing in the *International Journal of Nanotechnology*, he describes a mathematical simulation to show how a new type of nanoscale transistor might be coupled to a DNA sensor system to produce a characteristic signal for specific DNA fragments in a sample.

Samuel Afuwape of the National University, in San Diego, California, explains that a portable DNA sequencer could make life easier for environmental scientists testing contaminated sites. Clinicians and medical researchers too could use it to diagnose genetic disorders and study problems in genetics. Such a sensor might also be used to spot the weapons of the bioterrorist or in criminal forensic investigations.

The earliest DNA biosensors used fluorescent labels to target DNA, but these were expensive and slow. The next generation used mediator molecules to speed up the process and labeled enzymes to make the sensors highly selective for their target molecules. None of these systems were portable, however, and the current research trend is towards systems that use no molecular labels and have avoid costly reagents.

Nevertheless, DNA biosensors are already becoming ubiquitous in many areas, but the instrumentation is usually limited to the laboratory setting. Afuwape says that a commercially viable, off-the-shelf handheld DNA biosensor that could be used in environmental, medical, forensics and other applications might be possible if researchers could unravel the basic molecular machinery operating at the interface between sample and detector.

Afuwape suggests that a new type of electronic device, the ion-selective field-effect transistor (ISFET), might be integrated into a DNA biosensor. Such a sensor would be coated with thousands of known DNA sequences that could match up - hybridize - with specific DNA fragments in a given medical or environmental sample.

The key to making the system work is that the ISFET can measure changes in conductivity. Constructing a sensor so that the process of DNA hybridization is coupled to a chemical reaction that generates electricity would produce discrete electronics signals. These signals would be picked up by the ISFET. The characteristic pattern of the signals would correspond to hybridization of a known DNA sequence on the sensor and so could reveal the presence of its counterpart DNA in the sample. Afuwape's mathematical work demonstrates that various known chemical reaction circuits involving DNA could be exploited in such a sensor.

"The ISFET is proving to be a powerful platform on which to design and develop selective, sensitive, and fast miniature DNA sensors," says Afuwape, "such portable DNA sensors will find broad application in medical, agriculture, environmental and bioweapons detection."

Source: Inderscience Publishers

Citation: Handheld DNA detector (2008, March 10) retrieved 2 May 2024 from https://phys.org/news/2008-03-handheld-dna-detector.html