Micro-gyroscopes that can detect cancer

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Image: mini gyroscope

A vibrating disc no bigger than a speck of dust could help to diagnose and monitor common types of cancer and provide specialists with information about the most appropriate therapy.

The European Commission has this month awarded 12 million Euros to an international consortium led by Newcastle University, England, to develop the biosensor technology towards clinical trials stage.

The research team aims to produce a hand-held device which would enable samples of blood, smear or biopsy to be tested quickly and accurately, for signs of cancer of the breast, cervix, colon or rectum.

The device would identify 'cancer specific markers' - proteins or other molecules produced by cancer cells - which vary according to the type of cancer and are distinct from proteins produced by healthy cells.

The researchers have manufactured discs less than one-tenth of a millimetre in diameter and coated them with special patterns of DNA or proteins which cause the cancer-specific markers to bind to the surface.

The discs are created in a silicon wafer and made to vibrate electronically in two modes. When a cancer-specific marker binds to the surface of a disc, in the pattern of the coating, the uneven weight causes one of the modes of vibration to change in frequency.

The difference between the frequencies of the two modes of vibration is measured, enabling the detection of tiny amounts of cancer specific marker. In theory, even the weight of a single molecule binding to the surface of a disc could be detected. .

Professor Calum McNeil, of the School of Clinical and Laboratory Sciences at Newcastle University, who is leading the project, said: 'We are confident that this new technology has the potential to improve the prospects of successful treatment for these cancers'.

'Early diagnosis and effective monitoring of cancers are known to be key factors influencing outcome. In addition, the technology could provide specialists with advice about the most appropriate therapy for a particular patient, since the devices could easily be connected to sources of information such as a hospital computer network, the internet or a mobile phone.'

Initial research was funded by the LINK Analytical Biotechnology Initiative, sponsored by the Biotechnology and Biological Sciences Research Council (BBSRC) and the Department of Trade and Industry.

The technology could eventually be developed for other types of cancer and a range of other diseases, including those caused by bacteria. This opens up the possibility of hospitals being able to screen new patients and visitors for MRSA, tuberculosis and other diseases to prevent the infections being carried into the wards.

Potential uses do not stop at medicine. In theory, the technology could be used to detect particles from biological or chemical weapons, providing an early warning system against terrorist attacks.

Professor McNeil collaborated closely with colleagues in engineering and life sciences at Newcastle University*. In fact, the idea of vibrating discs was inspired by earlier work at the University involving the manufacture of micro-gyroscopes, which are now standard equipment in many devices that detect movement, from navigation equipment to car air-bags.

At the heart of a micro-gyroscope is a vibrating disc that must be almost perfectly formed to operate correctly. Professor McNeil realised that a near-perfect disc could be turned into an extremely sensitive weighing machine because the addition of a tiny weight would make it vibrate unevenly.

European Commission funding for the project, known as Smart Integrated Biodiagnostic Systems for Healthcare, or SmartHEALTH for short, officially begins in December 2005, via the European Commission's Framework 6 programme.

Source: Newcastle University