Revolutionizing the diagnosis of serious disease

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Revolutionary ultrasonic nanotechnology that could allow scientists to see inside a patient's individual cells to help diagnose serious illnesses is being developed by researchers at The University of Nottingham.

The new technique would utilise ultrasound technology — more commonly used to look at whole bodies such as fetal scanners — to look inside cells. The components of the new technology would be many thousand times smaller than current systems.

The technology would be tiny enough to allow scientists to see inside and image individual cells in the human body, which would further our understanding of the structure and function of cells and could help to detect abnormalities to diagnose serious illnesses such as some cancers.

The work by the Ultrasonics Group in the Division of Electrical Systems and Optics has been deemed so potentially innovative it has recently been awarded a £850,000 five-year Platform Grant by the Engineering and Physical Sciences Research Council (EPSRC).

Ultrasound refers to sound waves that are at a frequency too high to be detected by the human ear, typically 20 kHz and above. Medical ultrasound uses an electrical transducer the size of a matchbox to produce sound waves at much higher frequencies, typically around 100-1000 times higher to probe bodies.

The Nottingham researchers are aiming to produce a miniaturised

version of this technology, with transducers so tiny that you could fit 500 across the width of one human hair which would produce sound waves at frequencies a thousand times higher again, in the GHz range.

Dr Matt Clark of the Ultrasonics Group, said: "By examining the mechanical properties inside a cell there is a huge amount that we can learn about its structure and the way it functions. But it's very much a leap into the unknown as this has never been achieved before.

"One of the reasons for this is that it presents an enormous technical challenge. To produce nano-ultrasonics you have to produce a nano-transducers, which essentially means taking a device that is currently the size of a matchbox and scaling it down to the nanoscale. How do you attach a wire to something so small?

"Our answer to some of these challenges is to create a device that works optically — using pulses of laser light to produce ultrasound rather than an electrical current. This allows us to talk to these tiny devices."

The new technology may also allow scientists to see objects even smaller than optical microscopes and be so sensitive they may be able to measure single molecules.

In addition to medical applications, the new technology would have important uses as a testing facility for industry to assess the integrity and quality of materials and to detect tiny defects which could have an impact on performance or safety.

Ultrasonics is currently used in applications such as testing landing gear components in the aero industry for cracks and damage which may not be immediately visible or may develop with use.

The group is also looking at developing new inspection techniques for

inspecting engineering metamaterials — advanced composites that are currently impossible to inspect with ultrasound. These materials offer huge performance advantages allowing radical new engineering but can't be widely used because of the difficulty of inspection.

Dr Clark added: "We are also applying our technology to nanoengineering because we have to match the enormous growth in nanotechnology with techniques to inspect the nanoworld. As products and their components become ever tinier, the testing facilities for those also need to be scaled down accordingly.

In NEMS (nanoelectromechanical) and MEMS (microelectromechanical) based machines there is an increasing demand for testing facilities which offer the same capabilities as those for real-world sized devices."

Source: University of Nottingham (news : web)