T-ray breakthrough could make detecting disease far easier

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A breakthrough in the harnessing of 'T-rays' - electromagnetic terahertz waves - which could dramatically improve the detecting and sensing of objects as varied as biological cell abnormalities and explosives has been announced.

Researchers at the University of Bath, UK, and in Spain have said they have found a way to control the flow of terahertz radiation down a metal wire. Their findings are set out in a letter published in the current journal *Physical Review Letters*. The title of the letter is: "Terahertz surface plasmon polariton propagation and focusing on periodically corrugated metal wires".

Terahertz radiation, whose frequency is around one thousand billion cycles a second, bridges the gap between the microwave and infrared parts of the electromagnetic spectrum.

Materials interact with radiation at T-ray frequencies in different ways than with radiation in other parts of the spectrum, making T-rays potentially important in detecting and analysing chemicals by analysing how they absorb T-rays fired at them.

This would allow quality control of prescribed drugs and detection of explosives to be carried out more easily, as many complex molecules have distinctive signatures in this part of the electromagnetic spectrum.

T-ray applications are presently limited by the relatively poor ability to focus the rays, which is achieved using the conventional means of lenses and mirrors to focus the radiation. This limits the spot size of focused T-rays to a substantial fraction of a millimetre and this has made studies of small objects such as biological cells with high resolution are virtually impossible.

But in their work the researchers found that although ordinary metal wire would not guide T-rays very well, if a series of tiny grooves was cut into the wire, it would do so much more effectively. If such a corrugated metal wire is then tapered to a point it becomes possible to very efficiently transport radiation to a point as small as a few millionths of a metre across.

This might, for example, lead to breakthroughs in examining very small objects such as the interior of biological cells where it might be possible to detect diseases or abnormalities. T-rays could also be directed to the interior of objects which could be useful in applications like endoscopic probing for cancerous cells or explosive detection.

“This is a significant development that would allow unprecedented accuracy in studying tiny objects and sensing chemicals using T-rays" said Dr Stefan Maier, of the University of Bath’s Department of Physics, who leads the research.

“Metal wire ordinarily has a limited ability to allow T-rays to flow along it, but our idea was to overcome this by corrugating its surface with a series of grooves, in effect creating an artificial material or ‘metamaterial’ as far as the T-rays are concerned.”

“In this way, the T-rays can be focused to the tip of the wire and guided into confined spaces or used to detect small objects, with important implications for disease detection or finding explosive that are hidden.”

Dr Maier is working with Dr Steve Andrews at Bath, and with Professor Francisco García-Vidal, of the Universidad Autónoma de Madrid, and Luis Martín-Moreno, of the Universidad de Zaragoza-CSIC.

The project, which is funded by the Royal Society in the UK, the EU and the US Airforce, is one year into its three-year term. The researchers hope to produce a working model within a year.

Source: University of Bath

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