

January 2007

HORIZON SCANNING SR008

HSE HORIZON SCANNING INTELLIGENCE GROUP SHORT REPORT**TERAHERTZ TECHNOLOGY****1. Issue**

Terahertz radiation (THz) is in a region of the electromagnetic spectrum between the Infrared and Microwave frequency ranges, which is as yet largely untapped in terms of its potential applications. However, as noted in a recent Foresight study,¹ the appearance of relatively cheap, coherent (laser) sources and detectors for Terahertz radiation is now leading to the exploitation of this spectral region being investigated seriously.

Status: HSE Action

The key features of THz radiation are that it can penetrate a wide range of materials such as human tissue, clothing, paper, wood, plastic and ceramics and that being non-ionising (unlike X-rays for example), it is not expected to damage DNA. These properties open up a variety of future commercial opportunities of which security and medical imaging applications offer perhaps the greatest potential.² It should be noted, however, that at the present time, the majority of systems under evaluation for security screening at airports, railway stations and the like, appear to operate in the adjacent 'Millimetre Wave' region, despite in some cases being referred to as using Terahertz technology.³

The first commercial Terahertz imaging and spectroscopic systems are now becoming available and in addition to medical and surveillance uses, applications are foreseen in drug discovery and non-destructive testing of foodstuffs, coatings and semi-conductor chips.

2. Relevance to Occupational Health & Safety

Relatively little appears to be known definitively about the possible health & safety implications of exposure to Terahertz radiation. A recent EU project aimed at examining this area (THZ-BRIDGE)⁴ concluded that:

- *Under various exposure conditions no biological effects could be detected.*
- *However, under some specific conditions of exposure, an induction of genotoxicity was observed to occur in lymphocytes.*
- *Medical Imaging employing appropriate exposure parameters is probably unharmed at least for single exposures.*

¹ D.J.Paul, Foresight Exploiting the Electromagnetic Spectrum, "Picturing People: Non-Intrusive Imaging", Office of Science and Innovation, 2005, <http://snipurl.com/xssx>

² see e.g. the THz Science & Technology Network at: <http://www.thznetwork.org/wordpress/>

³ The generally accepted definition of the two regions is that THz extends from 300GHz to 10Hz, while 'Millimetre Wave' covers the range from 30GHz to 300GHz.

⁴ [http://www.frascati.enea.it/THz-BRIDGE/reports/THz-BRIDGE Final Report.pdf](http://www.frascati.enea.it/THz-BRIDGE/reports/THz-BRIDGE%20Final%20Report.pdf)

- *Some effects were observed to be induced by the THz radiation at a relatively low intensity when compared to the limits set by the ICNIRP for exposure.*

A key recommendation from this report was that “studies should be extended to establish more accurate dose-response relationships.”

Thus it seems that there is a degree of uncertainty still at present as to the potential for harmful occupational exposure from the use of THz radiation.

3. Implications

The potential use of Terahertz technology in applications such as airport scanners, medical imaging systems and industrial quality control could lead in future to widespread exposure of operators (and the public) to THz radiation. However at this early stage it is very difficult to predict the extent of any occupational exposure in terms of the number of workers likely to come into contact with the technology.

Similarly, given the shortage of definitive information as to any possible adverse health effects arising from exposure, generating guidance as to safe exposure limits and appropriate control measures will be problematic.

As with other emerging technologies the development of the application of Terahertz radiation and the understanding of its possible effects on human health are still at an early stage. Consideration will therefore need to be given to how best to maintain a balance between ensuring operator safety whilst enabling effective commercial development of this new technology.

4. Recommendations

It is suggested that HSE should critically examine the output from existing research into the potential health effects of Terahertz radiation in order to enable interim guidance on the topic to be developed. Where appropriate, HSE could consider supporting additional investigations in the field.

Developments in the field should continue to be monitored through on-going Horizon Scanning activity, taking into account the views of equipment developers and manufacturers, together with potential end users of Terahertz technology.

Roger Brentnall, Horizon Scanning Section, HSL