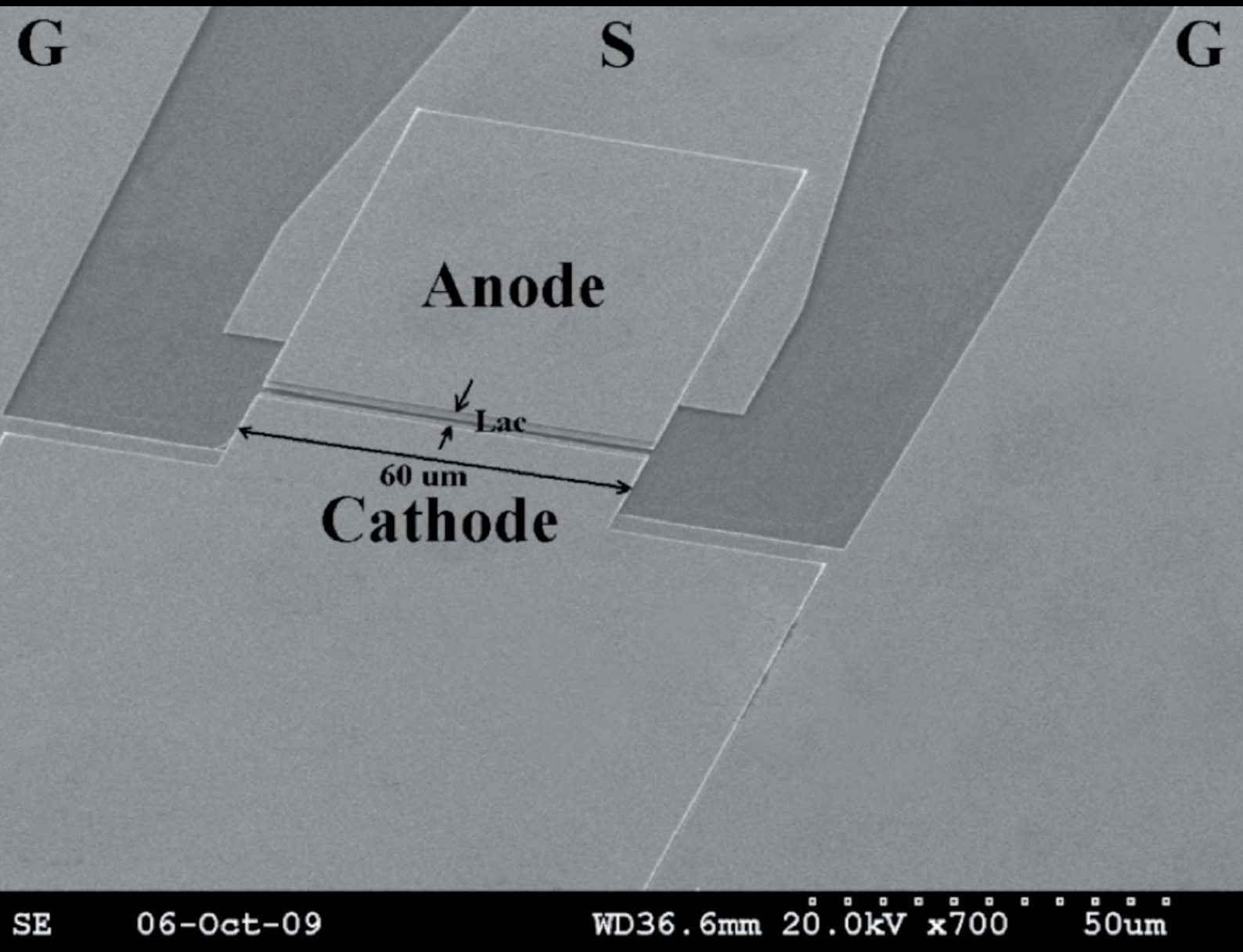
University of Glasgow

T-ray technology



T-ray technology is on the horizon

Researchers at the Universities of Glasgow and Aberdeen are collaborating with a business to produce low power hand held devices generating high frequency sources of terahertz (THz) radiation that can be used in high resolution radar and imaging technology.

Terahertz radiation has the potential to be used in a wide range of applications such as civilian and military radar, security screening devices for airports that can see through clothing so that security guards do not need to do physical pat down searches, and treating conditions such as burns, bed sores and skin cancer.

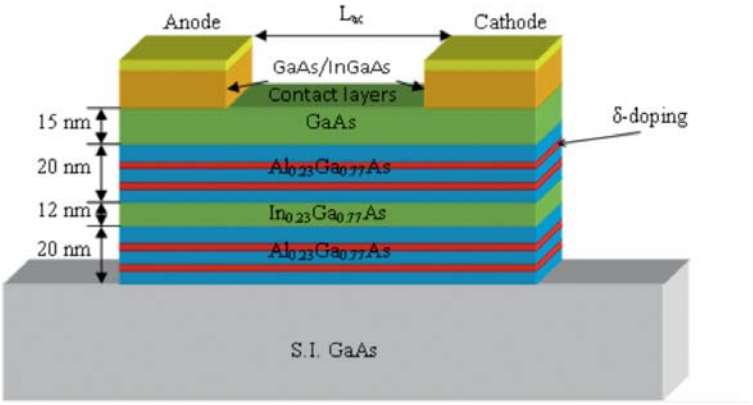
THz is a cutting edge technology that has been dubbed by the press as T-rays. Until less than a decade ago, the only main viable sources of THz radiation were the backward wave oscillator, the gyrotron, far infrared lasers, free electron lasers, quantum cascade lasers, synchroton light sources, and photomixing sources.

What is holding back the widespread use of THz technology in science, medicine and business is that researchers have been unable to produce enough reliable sources of the radiation at a high enough frequency - above 200 GHz – to make it viable. For example, quantum cascade lasers can make the radiation, but this has to be cryogenically cooled, the equipment is large and complex which uses up an awful lot of energy.

Professor David Cumming, Chair of Electronic Systems at the University of Glasgow, and Dr Geoff Dunn, lecturer in theoretical physics at the University of Aberdeen, are working with e2v, a Lincolnshire-based business, to develop Planar Gunn diode technology, that will produce THz radiation at higher frequency that will enable the technology to become commercially viable.

Prof Cumming and his team have been working with e2v since 2007 and have received Engineering and Physical Sciences Research Council (EPSRC) money to fund a PhD student and post-doctoral student to work on the project.

Prof Cumming had developed prototype Planar Gunn diode technology that operated at almost 110 GHz, so the basic science is understood. The research project involves increasing the electron density in the diodes to get the frequency up to as high as 300 GHz. Working with e2v, the university researchers have optimised the geometry and materials, particularly at key frequencies identified by the company.



Schematic view of epitaxy layers of planar Gunn diode.

Using simulation tools that will incorporate electronic and thermal models, the researchers are developing an advanced understanding of how the technology works to improve the power output of THz radiation at these high frequencies using Planar Gunn diodes.

The research project aims to further develop the potential of these devices to allow them to be integrated into Monolithic Microwave Integrated Circuit (MMIC) circuitry that e2v can use for a wide range of applications.

Integrating Planar Gunn diode technology into integrated circuits would substantially reduce production costs, and creating viable low-cost sources of THz radiation would strengthen the UK's position at the forefront of this exciting new technology.

One obvious application could be in screening at airports. Current technology uses x-rays, which use ionising radiation which can be potentially harmful, resulting in some public uneasiness. THz radiation, which allows security staff to see beneath clothing to detect concealed weapons or packages, is non-ionising and, therefore, harmless.

It can also be used for examining conditions on the surface of the skin such as cancer, bed sores and burns. Unlike x-rays, which penetrate the soft tissue to show up bones, THz radiation only goes a few millimetres into the skin.

"Terahertz has the capacity to revolutionise imaging technology."

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