Terahertz Spectroscopy and Imaging

Edmund Linfield
University of Leeds, United Kingdom

Internationally, over the last three years, the field of terahertz spectroscopy and imaging has undergone extremely rapid growth, with major developments being seen in terahertz components, terahertz systems and potential application areas. To name just three:

- Terahertz quantum cascade lasers have been demonstrated to operate at frequencies below 2 THz, and at temperatures above 160 K. They are also being incorporated into terahertz imaging systems;
- Terahertz spectroscopy and imaging systems, based on ultrafast (femtosecond) lasers, are being marketed to pharmaceutical companies, and used for the analysis of pharmaceutical compounds (for example, polymorphic transformations, and drug distributions in tablets);
- Terahertz spectroscopy is being considered by security agencies, around the world, as a potential technique for identifying drugs-of-abuse and explosives.

What developments will we see in the next three years and beyond?

- How much further will it be possible to develop quantum cascade laser based systems, and how well will they compete long-term with the already established commercial pulsed (femtosecond) spectroscopy and imaging systems?
- Will we see terahertz systems being used for security applications at airports, and will we see stand-off detection being implemented in real-life situations?
- Will we find on-chip terahertz systems being used commercially as biological sensors?
- What are the prospects now for using terahertz radiation for medical and dental imaging?
- What new applications may emerge, which hitherto have not been considered?

In this context, I will discuss our latest research in the field and survey what the international community has achieved.

The development of terahertz technologies is currently in an extremely exciting phase and it is an excellent time to discuss what the future may hold.