Since they were first demonstrated at Bell Laboratories in 1994, Quantum Cascade Lasers (QCL) have been gaining acceptance as the mid-infrared source of choice. Their shift out of the laboratory into real world applications has been accelerated by the step change in performance that these devices can deliver in fields as diverse as range finding, electronic counter measures, Free Space optical telecoms and chemical sniffing. It is in this last field, chemical sniffing, that perhaps the biggest opportunities can be found as the combination of QCLs and recent gas sensor developments promise to deliver superior levels of spectroscopic performance in terms of detection and selectivity. This will open up huge markets in continuous emission monitoring (CEM), health and safety, security, defence and medical diagnostics.

In the CEM market area, Cascade Technologies has successfully demonstrated direct across stack NOx monitoring using its Micro Sensor product. Part per billion (PPB) detection sensitivities, direct measurement and multi species capability with very low cross interference have bee demonstrated. The QCL based sensing platform has removed many of the question marks associated with traditional extractive techniques. By using the “intrpulse” technique, the platform benefits from ultra fast measurement providing immunity to outside noise influences such as turbulence and vibration and giving industrial performance equivalent to that seen in the laboratory. Time evolutions measurements of the gas species has indicated that signal degradation and drift are negligible. The ability to easily swap QCLs or multiplex them enable the platform to become a flexible monitoring solution and to target other industrial relevant species including SOx, NH3, CO and CO2. Key results will be presented.

Following successful use of QCL for trace gas detection in the continuous emission monitoring market, the core technology platform is now being developed towards homeland security applications. Preliminary results will be shown to highlight the potential of QCL based trace gas sensor for identifying vapours of explosives. Furthermore we will present results that let foresee the use of such technologies at addressing security gaps for protection against terrorism in infrastructures where high throughput screening of individuals or items is required. Preliminary measurements have shown that rapid identification, or fingerprinting, of explosive is achievable in 10ms at extrapolated sensitivities in the sub-PPB range.

The experiments were carried out with support form the Home Office Scientific Development Branch (HOSDB) in the UK and were focused at selecting a specific explosive compounds and identifying them using Cascade novel sniffer platform. Preliminary studies on the technology have demonstrated direct fingerprinting (identification) of explosive compounds such as Nitroglycerin (NG) and tagging agents such as Ethylene Glycol Dinitrate (EGDN) by sniffing surrounding ambient air. Furthermore these studies have also indicated that detection of such materials on packaging used to ship the sealed compounds is possible, making this platform a strong contender for detection through cross contamination on material that have been in contact with each other. It was also possible to identify breakdown products associated with sample material NG providing a further capability that could be exploited to enhance the detection and identification of explosive compounds.

1 Normand et al; Opt Lett 28,16, 2003
3 Normand et al; International Patent No. PCT/GB2003/001510