Baggage claim: Kromek is developing new X-ray scanning systems

Secure future

There's money to be made from developing cleverer equipment to improve security at places like airports. And, writes Ben Hargreaves, some of the inventions could also have uses in the medical field

Anyone who has travelled by air in the past seven years has experienced first-hand the strictures imposed by a heightened state of security. We live in cautious times, where debate rages in Parliament over longer periods of detention for terrorist suspects, and stories from the "war on terror" make headlines daily.

For those smaller engineering firms with innovative anti-terrorism technology to bring to market, the current climate is proving fertile, even as economic doom and gloom seems to hold sway.

Professor Max Robinson, an entrepreneur whose high-tech firm is based in Sedgefield, County Durham, believes his company is set to benefit from a need for enhanced security systems. And his business is certainly proving successful at attracting investment, even during the credit crunch. In the year to June, Robinson's firm, Kromek, which began life five years ago as Durham Scientific Crystals, raised more than £5 million in fresh investment, and secured a £250,000 R&D grant from the One NorthEast development agency.

Kromek is located on a science park in a town most notable for being Tony Blair's former constituency, and where skilled workers from the local semiconductor manufacturing industry are readily available.

Colour key: X-ray scans of liquids

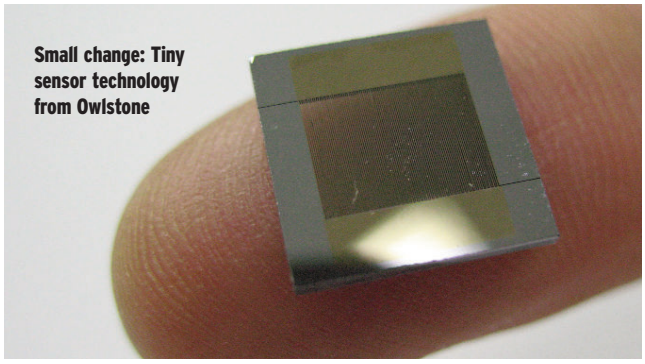
"We're not having a problem attracting the kind of staff we need, despite the perception of skills shortages in industry," says Robinson. His company is hoping to capitalise on a need for security equipment such as advanced X-ray scanners for airports, based on its cadmium telluride detectors.

The detectors – a compound semiconductor – are made through a vapour-based process, as opposed to liquid, which has advantages in terms of repeatability, quality and yield, says Kromek. "The material as product has always been variable, and there are problems with yield, and it's stopped mainstream applications coming online," says Robinson. "Manufacturers have almost invented their way around it."

Kromek chief executive Arnab Basu believes a "paradigm shift" is on the horizon as manufacturers are able to use cadmium telluride on a large, commercial scale for the first time.

Rather than developing the detectors and supplying them to other companies, Kromek saw an opportunity to produce complete pieces of equipment based on its technology. So it is developing its own X-ray scanning and imaging equipment, in which 3D colour images can be created thanks to the cadmium telluride systems. "We realised we could leverage high-value pieces of equipment," says Robinson. "The company became more about imaging, and our name change reflected this."

With Kromek's kit, not only is it possible to rotate a three-dimensional X-ray image without



Small change: Tiny sensor technology from Owlstone

moving the item being scanned, it is also possible to identify materials, discriminating between different types of liquid, for example. This has obvious applications in the identification of, say, liquid explosives – a pertinent issue since the 2006 plot to blow up transatlantic airliners.

The Home Office awarded Kromek £350,000 to develop new X-ray scanners based on cadmium telluride detectors, and a scanner that can provide an operator with a simple yes/no answer as to whether a liquid can be safely carried on board a plane is one of the results. The two milestones – the production of 3D, animated X-rays and the identification of different liquids – are requirements of the contract with the government, Kromek says.

It is the identification of materials being scanned that is particularly significant, according to Robinson. "The analogy I like to use is that, if there were CCTV cameras in the room, detecting someone coming in is one level. But actually identifying who that person is, that's quite different. The distance between the two is marked."

At the heart of the system are a number of proprietary technologies with clever software that can interpret the data from the detector. "We have algorithms that you need to tease out that vital identification information," he says.

Of the decision by Kromek to develop its own scanning systems, at least initially, he adds: "These are new kinds of detectors with new kinds of output and capability. If we just sold the detectors it would be difficult for the customer or end user to adopt them and get the benefits." The company is, however, working in conjunction with a number of leading X-ray scanner manufacturers, and may license technology to them at a later date.

The team at Kromek has expanded to embrace more than 30, many of whom are PhD-level scientists and engineers. "It's frightening how clever some of them are, and they are generating a lot of new intellectual property all the time," says Robinson. There are now more than 20 patents for Kromek technology, he adds.

In the liquid scanner, the bottle moves through the X-ray beam to ensure that no part of a liquid escapes. "The beam tracks down the axis of the bottle, which means that if there's a difference, or a particular liquid has been sectioned off, it will be detected, and that's a feature that's had very favourable comments from the market," says Robinson.

Kromek will not stop at the security market, ideal as it is for the cadmium telluride technology. It is developing a machine for quality standard industrial applications, and also expects the technology to find its way into the medical arena, where it could revolutionise X-ray scanning, Robinson believes. "With the energy discrimination of the system, the beam of the X-ray spectrum will be affected differently by healthy tissue or diseased tissue. Instead of just looking for a shape that's

anomalous, you're actually looking for a material that's anomalous."

Another small British business making inroads into the security market is Owlstone, a spin-out from the University of Cambridge which signed a deal to provide its technology to the US Department of Defense last year.

Owlstone has developed a "dime-sized" sensor which has the ability to monitor and identify chemicals at very low concentrations in the atmosphere. Billy Boyle, the company's president of operations and a co-founder, says the US government was attracted to the Owlstone technology because of its potential for portability, in handheld units for example.

The silicon sensor uses a proprietary form of Field Asymmetric Ion Mobility (FAIMS), a variant of Ion Mobility Spectrometry (IMS), to detect chemical traces. There are possible applications in security, defence and industry. IMS is the current standard, but FAIMS can also be used to detect chemical warfare agents and explosives in the field. Boyle says: "With IMS the performance tends to degrade as the device shrinks in size. FAIMS provides us with a better chemical signature with more information for detection." It is because of this that its accuracy is said to be more than that of traditional IMS systems.

There is an economy of scale in the manufacture of Owlstone technology, with hundreds of sensors made together in parallel on a single silicon wafer. Owlstone works with semiconductor foundries in the UK and Europe. "At the moment we are focused on the security market but we see huge potential in medical devices," says Boyle.

Owlstone's technology does not rely on exotic materials and can be customised for different applications. Its low power makes it particularly suited to handheld or portable devices, says the company.

EQUIPPING THE DRUG-BUSTERS

Essex-based specialist technology manufacturer E2V is dipping into the security market with a new version of its Argus thermal-imaging camera targeted at the police. Currently being tested by six forces around the country, the Argus SC, like its counterpart for fire brigades, measures thermal radiation and not visible light. Based on the thermal radiation that hits the sensor through the lens, the camera creates an image that is displayed on an LCD screen.

The SC is a version of the Argus that narrows down the "dynamic range" of the original unit, which only firefighters require, to provide a high-performance model suited to police needs, based on their feedback. Thermal imaging, for example, can be used to locate houses used for drug dealing in a street of derelict properties.

Paul Spooner, product manager for thermal imaging at E2V, explains: "If, say, a property is being used to grow marijuana it may glow white on the imaging camera - hotter than other houses that are boarded up. That's grounds for the police to investigate further." Searching for fugitives, the Argus SC can track footprints in the dark. Police forces initially gave feedback on using the original version of the Argus, Spooner adds, but the SC is now production-ready.

The Argus SC is not the only foray E2V has made into the security market. Some of its other projects, which are confidential, go into military and anti-terrorism applications.

Police camera: The new Argus SC