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A review of the history of threat detection in airport baggage scanners :

New generation multi-spectral x-ray systems

Dr. Gary Gibson
Integrated Systems Manager

Kromek will be the leading provider of digital colour x-ray imaging enabling direct materials identification in the security, medical, industrial inspection and defense markets.

Profile

- Founded as Durham Scientific Crystals 2003
- Changed trading name to Kromek in 2008
- Based in North East England
- 40+ employees
- VC funded
- Basic technology protected through worldwide patents

Early history of airport x-ray scanners

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1970's:

Spate of hijacks in the early '70s leads to phased introduction of baggage scanners in airports:

'72 – Private patent granted to Peil for early generation baggage scanner detecting guns and explosives
'73 – Hounsfield (EMI Corp) publishes patent describing the first CT scanning apparatus for medical applications
'74 – Westinghouse Corp publishes patents describing automated baggage scanners which could be used for scanning for guns in airports
'76 – First dual energy x-ray scanners patented in medical field

Early history of airport x-ray scanners

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1980's:

'80 – Snow & Giacomelli (USA) publish patent for determining accurate density of objects using scattered radiation

'82 – Kotowski (ScanRay Corp) publishes patent on first digital capture signal using scintillators and Si detectors

'86 – Private patent granted to Macovski which describes a dual energy scintillator system

'88 – Donges (Heimann Corp) publishes patents improving conveyor and x-ray stability

'89 – Annis and Bjorkholm (AS&E) publish Compton backscattering patent for identifying low Z materials

History of airport x-ray scanners

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1990's:

'93 – Kotowski (Private filing) publishes patent detailing process of generating three dimensional images of objects using Compton scattering.

'93 – Smith (IRT Corp) patent setting out Compton backscattering technique for body scanning

'94 – Krug et al. (Vivid Corp) publish patent for threat material identification using dual energy scanners

'96 – Gordon et al. (Analogic Corp) publish patent proposing dual energy detectors in CT scanners for threat identification

'98 – Geus (Heimann GmbH) publish patent describing XRD technique to help to identify threats

History of airport x-ray scanners

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2000's:

Twin towers disaster leads governments to focus on airport security, new threat of liquid explosives:

2000 – Krug et al. (Vivid Corp) publish patents detailing a multi-view threat detection system

2005 - Kotowski (Rapiscan Corp) publishes patent detailing remote imaging system for x-ray scanners

2006 – Naumann et al. (Heimann GmbH) publish patent describing multi-source, multi-view threat detection system

2006 – Ellenbogen et al. (Reveal Corp) publish patent describing a reduced size CT scanner for baggage

Technology breakthrough

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Main defining patents

’72 –Peil – 1st generation baggage scanners
’73 – Hounsfield (EMI Corp) - CT scanning
’82 – Kotowski (ScanRay Corp) – Scintillator technology
’86 – Macovski – Dual energy scintillator detectors
’89 – Annis (AS&E) - Compton backscattering
’93 – Smith (IRT Corp) – Compton body scanning
’94 – Krug (Vivid Corp) – Effective ‘z’ materials ID
’96 – Gordon (Analogic Corp) – Dual energy CT scanners
’00 – Krug (Vivid Corp) – Multi-view imaging
’06 - Naumann (Heimann GmbH) – Multi-source multi-view

Where next??

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Question:

When one considers that many of the current patents being issued are refinements on existing technology; the big question is where is the next leap in technology going to come from.

One answer:

Direct spectral detectors

The digital revolution

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The digital x-ray revolution

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The Importance of Color

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The Importance of Color

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Advantages of CdTe Systems

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High Resolution

output at low radiation doses

High Speed

real-time imaging

Colour x-ray

energy discrimination

Portable & Simple

no cooling

10x

more sensitive than silicon

- Better
- Cheaper
- Larger

Our products

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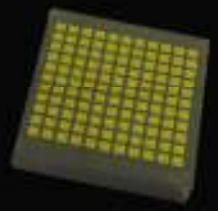
Materials

Substrates and detector grade materials

Detector

Pixellated and planar detectors with electronics



Sub-systems

Application specific sub-system assemblies with Kromek detectors

Platform Integration + Products

Selective high value-added system prototypes exploiting advantages of Kromek detectors

Product Roadmap : Security Sector

Technology Capability	Product	Product readiness	Route to market
Screening of single bottles which are open	Kromek Bottle Scanner™	Now	Direct
Screening of single bottles which are closed	Kromek Bottle Scanner™	Now	Direct
Screening of multiple bottles	Kromek 311+ Scanner; or Kromek Single Array upgrade module with threat materials identification software	June 2009	Direct for 311+ scanner and OEM for single array upgrade
Screening of bottles inside hand luggage	Kromek XRA™ upgrade module with threat materials identification software	Q1 2010	OEM

Kromek Bottle Scanner™ - Threat Identifier

- Identifies the presence of hazardous liquids in containers (Liquids, aerosols and gels).
- Threat database specified by customer
- Desktop Unit
- Quick: Scan, analysis & categorisation within 20 seconds
- Easy to Use: Single Button operation and simple Pass/Fail display
- Versatile: Portable, no consumables, scans containers of any shape, glass, plastic, metal 80-2000ml
- Simple threat database upgrade

Kromek Bottle Scanner™ - Verifier

- Detection of narcotics and contaminants in bottled liquids.
- Spectral fingerprinting of liquids and gels.
- Supplied with pre-programmed upgradeable database
- Quick: Scan, analysis & categorisation within 20 seconds
- Easy to Use: Single Button operation and simple Pass/Fail display
- Versatile: Portable, no consumables, scans containers of any shape, glass, plastic, metal 80-2000ml

Kromek 311+ Scanner

- Desktop Unit
- Multi spectral x-ray
- Identification and categorisation of liquids, aerosols and gels
- Quick: Scan, analysis & categorisation within 20 seconds
- Easy to Use: Single Button operation and simple Pass/Fail display
- Versatile: Portable, no consumables, scans containers of any shape, glass, plastic, metal 80-2000ml
- Simple threat database upgrade

Effect of energy resolution

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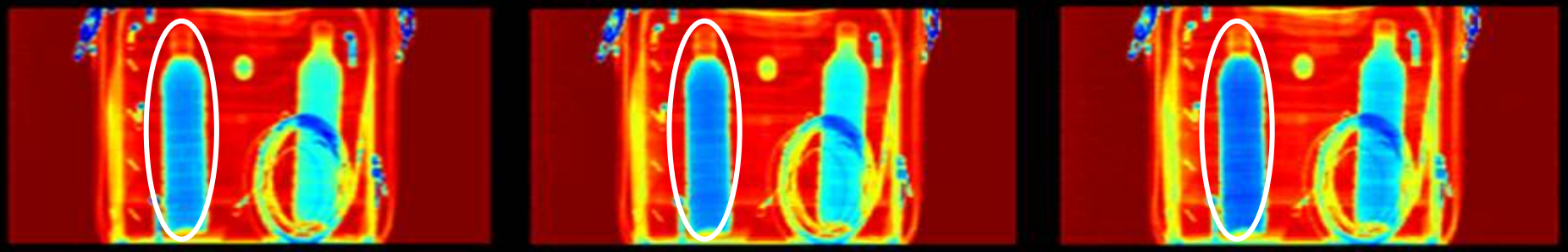


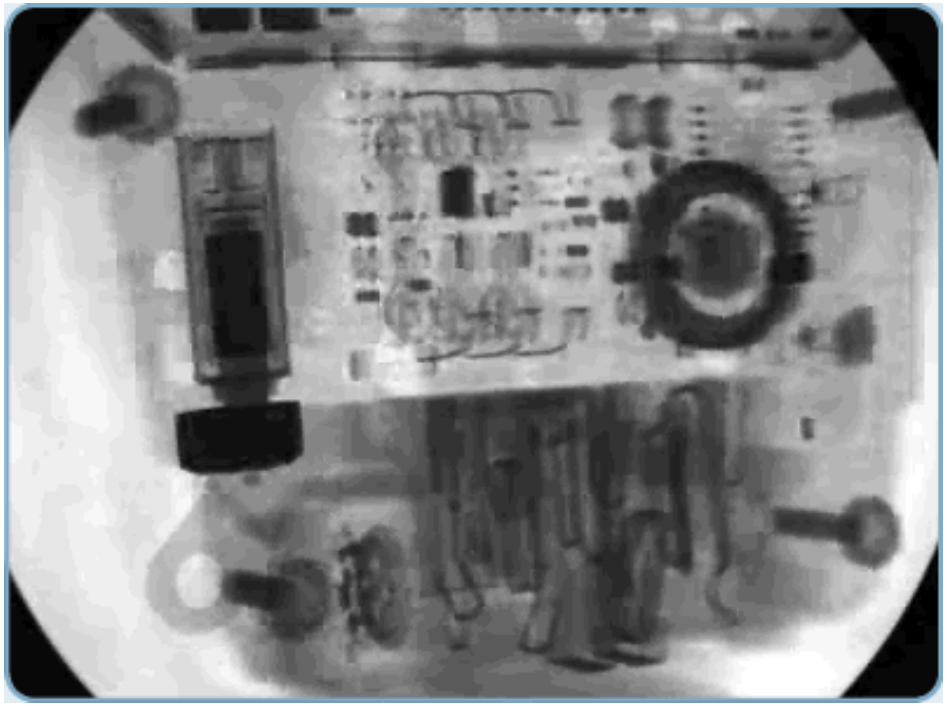
50keV 80keV 100keV

Large shifts in transmission can be seen with energy in the false colour image above

Scintillators smear the energy information received in conventional detectors reducing precision in determining effective ‘z’

Spectral detectors give precise data at multiple energies allowing for a step change improvement in materials identification capability – the next big breakthrough!!

Kromek XRA™



- 3D Imaging with materials recognition
- Multiple fan beams from a single source
- Exploits the physiological phenomenon of monocular movement parallax to create three dimensional view of object.
- Allows separation of layered or hidden parts
- Images combined to produce an animated 3D view of the object
- Gathers spectral x-ray information, uses kromek proprietary algorithms to determine material constituents of the object & correlates material assignments via voxel analysis

Summary

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There has been a rich history of innovation in the baggage scanners

Companies continue to invest in this area

Almost all areas of the science that can be exploited have been

The one area that has not yet been exploited to the fullest is the information contained in the transmission spectra

Spectral detectors free that information

THEY are the next big innovation to come

Thank you!!

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Any questions!

Patents published by company