

REDFINCH CONSORTIUM



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Fully Integrated Mid-Infrared Chemical Sensors

Developing Photonic Integrated Circuits
at Mid-Infrared Wavelengths for the
Petrochemical and Dairy Industries

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PHOTONICS PUBLIC PRIVATE PARTNERSHIP

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Petrochemical factory image © Ergin Mikhail/fotolia.com

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TARGET APPLICATIONS

Process Gas Analysis in Refineries



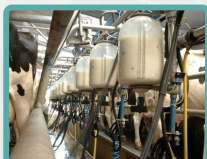
Multi-component process gas analyser
Fast response time allows rapid control decisions
Low maintenance and low sampling effort

Gas Leak Detection in Petrochemical Plants

Wireless sensor network for continuous monitoring
Mobile robot inspection vehicles for pipelines
Low power consumption and high dynamic range



Protein Analysis in Liquids for the Dairy Industry



In-line protein monitor on milk collection tank
Instant information on fat and protein content
Can discriminate between different fat proteins

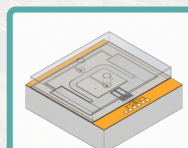
TECHNOLOGIES

Integrated Mid-Infrared Multi-Wavelength Laser Arrays

On-chip widely tunable laser module in the 2-8 μm range
Up to 30 lasers multiplexed into a small no. of outputs
Combines bonded QCLs, hybrid PhC lasers and GaSb on Si



On-Chip Photo-Acoustic Spectroscopy Sensors



Miniature PAS cell capable of sub-ppm chemical detection
Fully integrated μm -size PAS cell on Si will be realised
Proof of concept of intra-cavity PAS (enhanced signal)

On-Chip Sensors for Liquids

Mach-Zehnder interferometer PIC for proteins in liquid
Outperform standard ATR spectroscopy on-chip
 α -Lactalbumin and casein initial protein targets



TOOLS

SiGe Platform



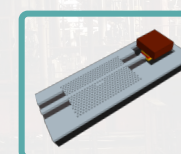
Well-developed SiGe on Si and SiGe on insulator processes
SiGe allows low propagation losses in whole 3-8 μm range
PIC structures fabricated in pilot line environment

III-V on Si Integration Capabilities

Heterogeneous integration - direct bonding of QCLs
Monolithic integration - growth of III-V on Si
Hybrid integration - pick-and-place technology



Hybrid Photonic Crystal Lasers



Gain chip coupled to SiGe/Si photonic crystal mirror
PhC mirrors allow high Q-factors in the range of 50-100k
Gain and wavelength selection can be optimised separately