Fully Integrated Mid-Infrared Chemical Sensors

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

TARGET APPLICATIONS

Process Gas Analysis in Refineries
- Multi-component process gas analyzer
- 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 GeAs on Si

On-Chip Photo-Acoustic Spectroscopy Sensors
- Miniature PAS cell capable of sub-ppm chemical detection
- Fully integrated µm-sized 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

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

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

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

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REDFINCH is funded through the European Union’s Horizon 2020 Programme, Contract No. 780240.