C1 & C2 TECHNOLOGY

Background to Non-Dispersive Infrared Gas Detection of Carbon Dioxide

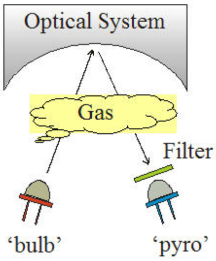

Figure 1

The Generic Technology

All gases absorb light at various specific frequencies; this attribute has been the basis of spectroscopy for more than 100 years. In most cases, the bandwidth of absorption is usually quite narrow, which has been exploited to provide 'spectrum finger prints' for all elements and compounds gaseous, fluid or solid.

The adjacent schematic (figure 1) provides the basic principle. Light is emitted from a source, passed through a gas, bounced, in this case, off a mirror, and then measured by a pyro-detector after passing through an optical filter that allows light to pass only at the most sensitive level for the gas being measured.

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The absorption spectra graph (figure 2) provides a visual representation of the signatures for some gases within the range of the C1 & C2 technology.

Mid-IR absorption fingerprints for gases of interest

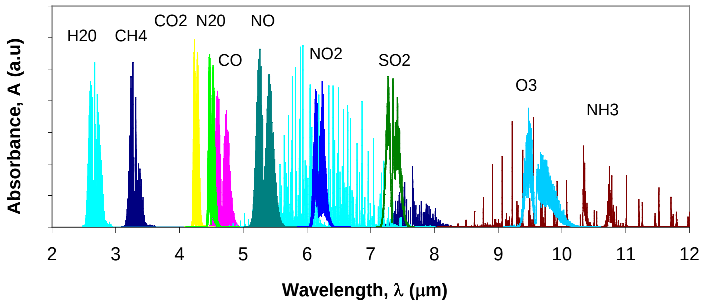

Figure 2

Infrared gas sensing methods have many advantages compared with other technologies. However, existing infrared sensors generally use thermal components (incandescent sources and pyroelectric or thermopile detectors) which have several disadvantages including slow response, limited wavelength range and require explosion proof housings to prevent the bulb acting as an ignition source.

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Replacing the incandescent sources and thermal detectors with high performance LEDs and photodiodes offers many advantages including low power and fast response (figure 3).

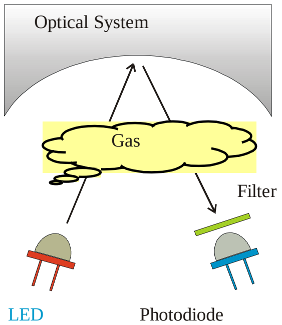

Figure 3

The C1 and C2 technologies (figure 4: a 1mm^2 LED chip) are based on the narrow band-gap III-V material, Indium Aluminium Antimonide ($In_{(1-x)}Al_xSb$), grown on a Gallium Arsenide (GaAs) substrate. The band-gap of which can be tuned to a very narrow width to provide emission and detection that is specific to Carbon Dioxide (CO_2) gas without the use of optical filters. Recent advances in material growth of this ternary alloy have led to improved LED internal efficiency, η_{int} , and improved detector responsivity and sensitivity. As a result, the C1 and C2 sensors will accurately measure CO_2 gas concentrations.

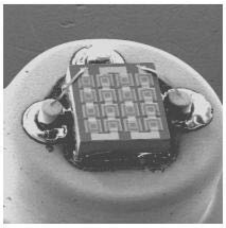

Figure 4

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SUMMARY

- CO_2 Solid State InSb sensor, utilising patented technology and worldwide exclusive license.
- Two readings per second – sensor measuring in real time, or selected average; no further signal processing required; drive voltage 5V.
- LED technology allows sensor to operate at low power <100mW; poison resistant.
- LED & matched PD operating within narrow optical band centred at 4.26µm.
- Technology delivers high speed; low power consumption; sunlight immunity; real time; accuracy.

C1 & C2 Technology	Existing Infrared Technology
Hydrophobic Filter, Sunlight immunity	Sunlight Filtering required
Low power consumption	100mw++
Fast Response: 2 measurements/sec	Response governed by slow modulation speed
T90 <4 seconds	T90 typically 20s+
Filter incorporated at epi wafer	Separate optical filter required
LED & PD no filter (LED & PD are tuned to the wavelength of CO_2 during wafer growth (Figure 4)	Incandescent sources (light-bulbs) & Thermal detectors + Optical Filter
Operation during and storage over a broad temperature range	
Selectable averaging or real time measurement	

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Figures 5 & 6 provide a detailed breakdown of the Sensor.

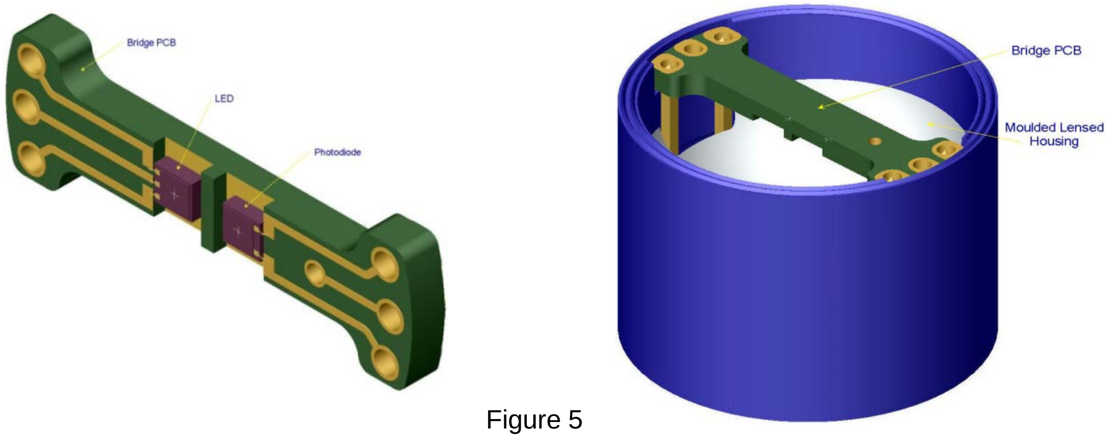

Figure 5

- Simple design
- No moving parts
- Large aperture for rapid diffusion
- Optical filtering built into chipset

LED & PD mounted on a bridge board PCB over lensed mirror reflector and drive electronics.

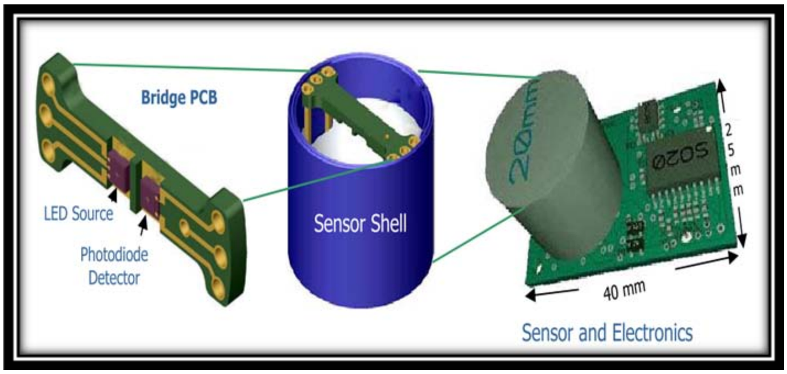

Figure 6

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