ANTI-FRINGING TECHNOLOGY

TECHNOLOGICAL NOTE

Laser absorption spectroscopy is of great interest for gas detection in a variety of applications including security, industrial process control, environmental protection and healthcare.

Optical spectroscopic techniques in general, and laser-based techniques in particular, offer high speed and high precision capabilities for the detection and monitoring of numerous gas species.
Unfortunately, signal fluctuations (noise) are strongly influenced by the presence of optical fringing effects (also called etalon effects) – which is a limiting factor in laser absorption spectroscopy.

Optical fringing is determined as the local signal amplitude to its mean value ratio (see FIGURE 1):

$$F = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

Optical fringing is a result of the interference of radiation reflected from the optical elements.

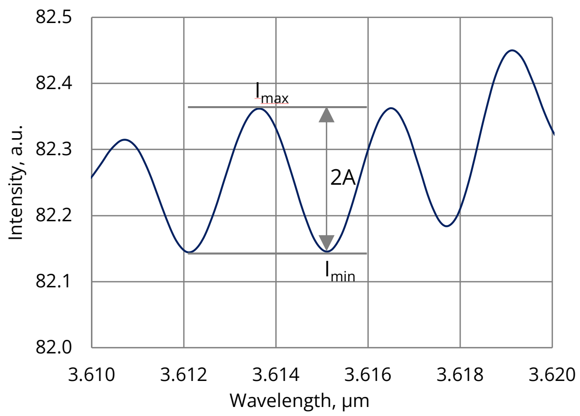

FIGURE 1. Optical fringing effect

The interference fringes stem from the optical system (Fabry-Pérot etalons between reflecting or scattering surfaces such as mirrors, lenses, optical fiber end faces, components of multipass cells, detector and laser package windows and semiconductor structure surfaces).

In VIGO infrared detectors fringes are generated mainly in GaAs substrate, due to its high refractive index n = 3.3.

Fringing increases significantly for radiation wavelength above λ_{peak}. This is due to the weaker absorption of long wavelengths in the absorber so more radiation is reflected from the metallization of the detector structure, contributing to greater fringing (see FIGURE 2).

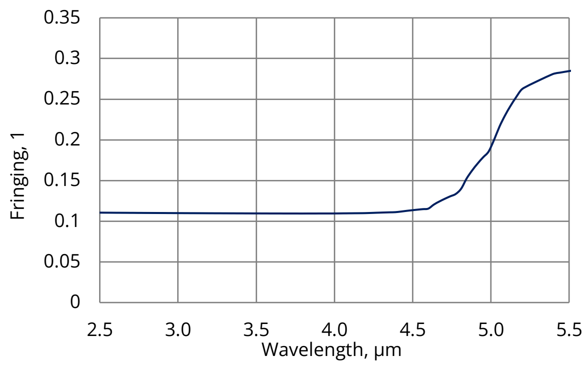

FIGURE 2. Theoretical calculations of fringing vs. wavelength in MWIR standard IR detector illuminated by coherent radiation

VIGO anti-fringing technology means the internal modification of the detector structure. After the growth, the wafer is characterized and specially processed to manufacture detection structures immune to generating optical fringes.

This results in the fringing 10 – 40 times smaller compared to the standard IR detector (see FIGURE 3, FIGURE 5, FIGURE 5 and FIGURE 6).

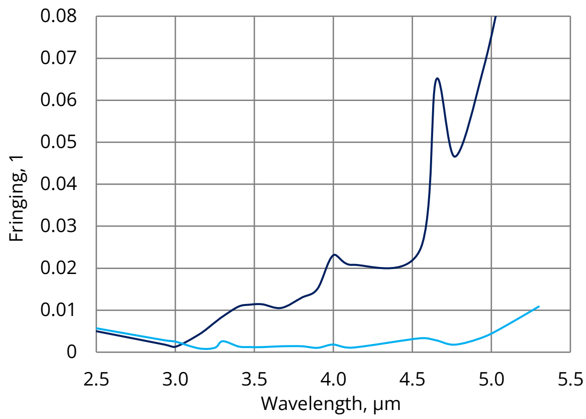

FIGURE 3. Fringing in an exemplary MWIR standard detector (dark blue line) and detector with anti-fringing technology applied (light blue line)

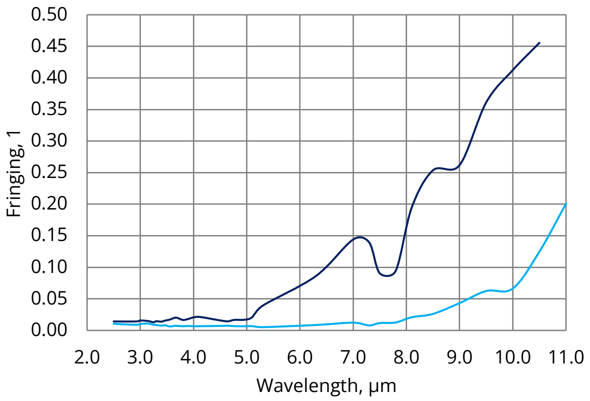

FIGURE 4. Fringing in an exemplary LWIR standard detector (dark blue line) and detector with anti-fringing technology applied (light blue line)

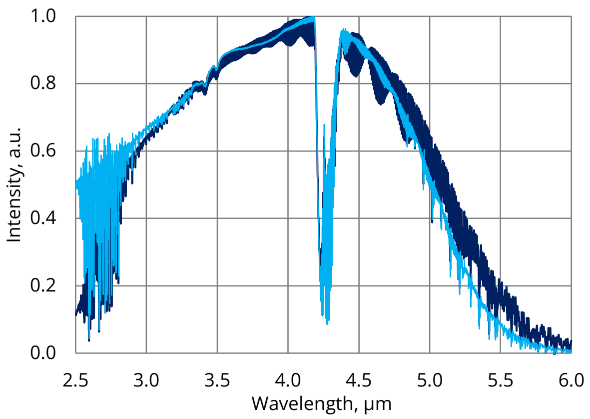

FIGURE 5. Normalized spectral characteristics of an exemplary MWIR standard detector (dark blue line) and detector with anti-fringing technology applied (light blue line)

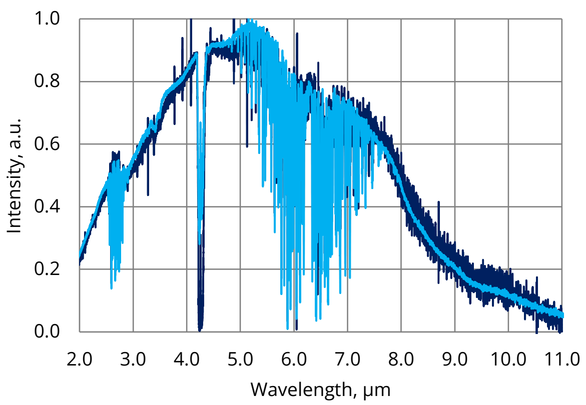

FIGURE 6. Normalized spectral characteristics of an exemplary LWIR standard detector (dark blue line) and detector with anti-fringing technology applied (light blue line)

Additionally, this modified detection structure can be anti-reflection coated (available upon request). It slightly improves fringes reduction, but it may be of importance in very high accuracy applications, i.e. trace gas detection.

We can apply anti-fringing technology to all our detectors without immersion microlenses.

Available **engineering samples** of detectors with anti-fringing technology:

- PV-5-AF0.1×0.1-TO39-NW-90
- PV-5-AF1×1-TO39-NW-90
- PC-9-AF1×1-TO39-NW-90