MITIGATING REFLECTIONS IN INTEGRATED GAS SENSORS

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Optical gas sensing for environmental monitoring has become an active research topic in the last decade [1]. Among the different optical sensing configurations, silicon photonic integrated sensors stand as a compact, CMOS-compatible alternative. However, even small on-chip reflections can create significant fringes when the optical path length is varied, e.g., when the wavelength is swept for TDLAS-like measurements. These fringes can be critical for NIR sensors, as absorption signals are much weaker in this region than in the MIR. Here, we propose a signal-processing method based on minimum phase techniques [2]: by increasing the measurement bandwidth to around 2 nm we can completely remove the reflection artifacts through processing.

We apply this technique to sensors for methane detection in the 1650 nm region. Fig.1(a) shows a SEM image of the sensing waveguide. To enable light-gas interaction, a sensing window is opened in the silicon dioxide cladding. This abrupt transition between cladding and air is a source of reflections, creating a Fabry-Perot cavity. We have carried out a set of simulations of spectroscopic measurements, assuming realistic conditions based on electromagnetic simulations and our measurement setup. As seen in Fig. 1(b), by applying the minimum phase time filter technique we counteract the effect of the cavity, restoring the original signal. Spectroscopic measurements for the experimental validation of both our sensors and technique are currently in progress.

(a)

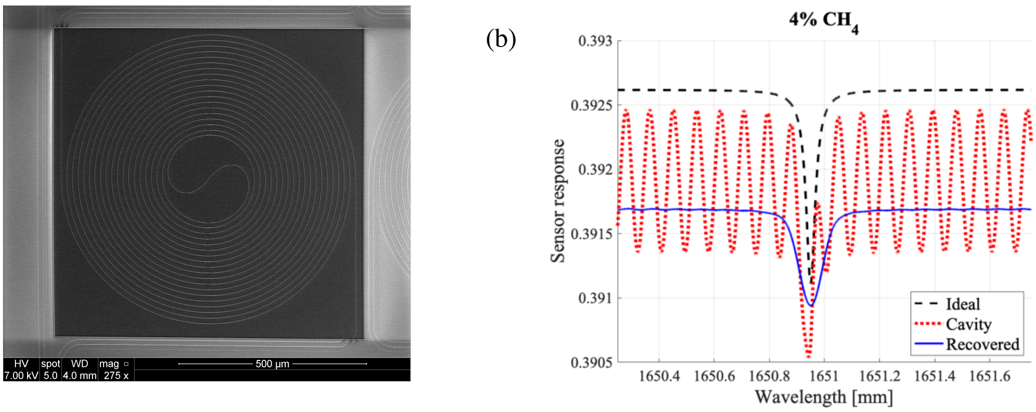

Figure 1. (a) SEM image of a sensing waveguide for methane detection on the NIR. (b) Simulation results of the application of our proposed technique to counteract the effect of spurious reflections.

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References:

[1] A. Hänsel and M. J. R. Heck, *Opportunities for photonic integrated circuits in optical gas sensors*, Journal of Physics: Photonics, 2, 2020.

[2] R. Halir, Í. Molina-Fernández, J. G. Wangüemert-Pérez, A. Ortega-Moñux, J. de-Oliva-Rubio and P. Cheben, *Characterization of integrated photonic devices with minimum phase technique*, Optics Express, 17(10), 2009.