Integrated optical gas sensors based on silicon photonics and 2D materials

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Abstract

Optical spectroscopy is among the most important chemical analysis techniques, due to its high specificity and long-term stability. For spectroscopic analysis of gas compositions, the mid infrared (mid-IR) region is particularly important, owing to the rovibrational resonances in that spectral range. Hence, there is great interest in miniaturizing and reducing the power consumption of optical spectroscopic sensors, but until recently the mid-IR range has been out of reach. Within the European projects ULISSES and AEOLUS, we are working on miniaturization of mid-IR optical gas sensors, by combining silicon photonics and 2D materials. We discuss our work on integrated optical waveguides [1,2], emitters [3] and detectors, as well as wafer-level packaging of sensors [4], and demonstrate spectroscopic sensing of carbon dioxide (CO_2) using an integrated silicon waveguide at the strong absorption peak at 4.23 µm wavelength.
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References

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Figures

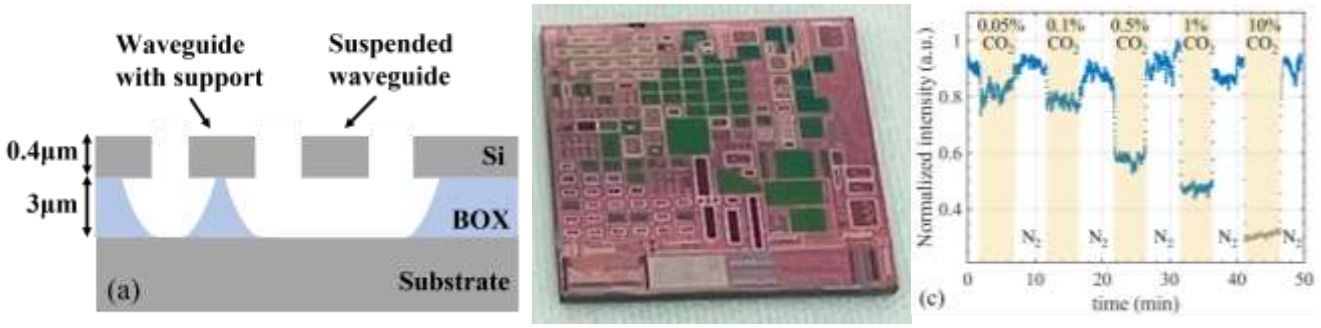

Figure 1: (a) Illustration of the waveguide cross-section. (b) Photonic chip with wafer-level sealed vacuum cavities [4]. (c) Sensing of five CO_2 concentrations with a 7 cm long waveguide. The signal at 10% CO_2 drops out of the sensing range [2].