

Gas sensing using silica high-mesa waveguide

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Population aging arises the requirement of health management. This may lead to the desire of compact health-check system that is used for daily health care. Breath sensing system is attractive because human-breath contains various disease-markers. Sensing using waveguide^[1-2] is one of the way to realize compact breath sensing system, and high-mesa waveguide can be used for breath sensing (gas sensing in human breath) owing to its unique structure of that core can contact to the outside gas. Fig. 1 shows the structure of high-mesa waveguide. When light propagates inside of the waveguide, a certain portion of the light profiles out from the waveguide which is utilized for gas absorption^[3].

Experiment system is shown in Fig.2. In the cycle loop, silica high-mesa waveguide (4.5cm length) is set in a hermetic chamber with CO₂ inside. The waveguide is pigtailed with standard fibers at the both facets. When a pulse light of 4ns pulse-width is injected into the cycle loop, 99:1 coupler depicts 1% of light power, and thus this power is evaluated at the oscilloscope. This system works like cavity ring down^[5] as the optical power decreases as the propagation light experiences higher cycle, and the gas concentration is evaluated by the decreasing time of the pulse light.

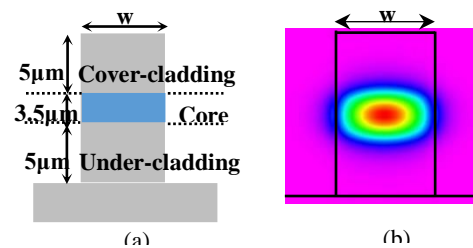


Fig.1 High-mesa waveguide. (a) Schematic cross section, (b) simulated

Fig. 3 shows waveforms we got at different concentration of CO₂. As shown in the figure, light intensity decreases much faster as CO₂ concentration decreases. This result proves clearly that gas absorption happened by using silica high-mesa waveguide. The absolute CO₂ concentration was estimated by using 1/e decay time (i. e., cavity ring down time) with comparison to “without CO₂” condition. The cavity ring-down times were estimated to be $\tau_g = 13.6\mu s$ for the case of 50% concentration of CO₂ and $\tau = 14.8\mu s$ for the case without CO₂, respectively. By using these cavity ring-down times, we estimated that the concentration was to be 46% that was similar to 50%.

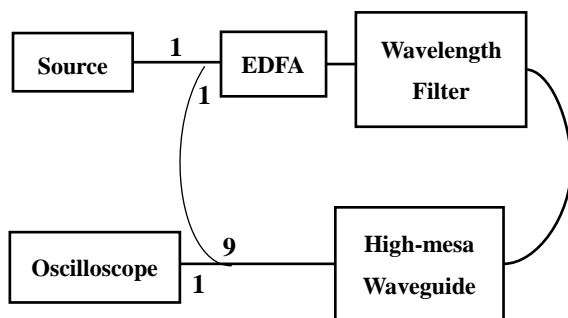


Fig.2 Experiment system based on CRDS system

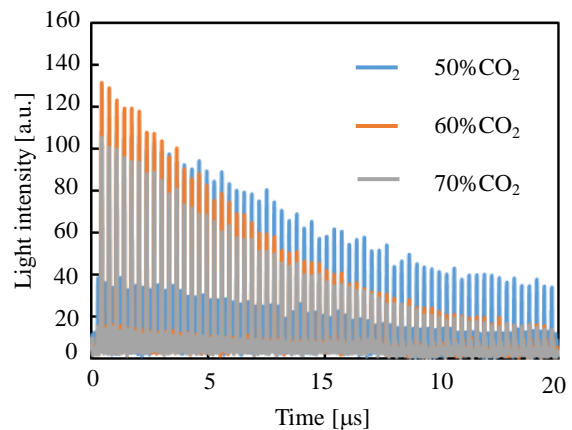


Fig. 3 CO₂ (50-70%) gas sensing

Reference

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