Loss Analysis on Sensing Waveguide

Jiao Chen, and Kiichi Hamamoto

Compact health-check system has been desired for an increasing demand on daily health-care, recently. Among many diagnostics methods, breath-content analysis is one of the candidates for daily health-care, as it contains various disease-markers and is noninvasive to human-beings. One of the attractive tools for breath-content analysis is infrared spectroscopy due to its superior capability in ppm-order sensitivity of various kinds of breath contents [1]. We have researched on a compact breath-sensing system by utilizing photonic integrated circuits with telecom-band infrared spectroscopy. From this viewpoint, high-mesa waveguide is attractive for its potential of being utilized for infrared absorption [2]. However, one of the critical issues for high-mesa waveguide lies in its high propagation loss, since high propagation loss consumes light power, which restricts sensing limitation [3]. We have reported that the scattering loss is the main loss contributor for SOI based high-mesa waveguide and the scattering loss can be decreased by utilizing mid-infrared light and thicker core thickness. As result, we prove that the scattering loss can be decreased to 0.072dB/cm, theoretically.

This time we proposed Silica high-mesa waveguide for its low propagation loss possibility, as shown in Fig.1. The evaluated propagation loss as a function of waveguide width is shown in Fig.2. The propagation loss shows 0.65dB/cm when w=2.3μm, which is higher than expected value of lower than 0.1dB/cm. Because the refractive index difference between core and cladding is only 2.5%, we suspected that maybe the radiation loss takes a large part of propagation loss. We evaluated the relation between the propagation loss and under-cladding layer thickness which is shown in Fig.3. From Fig. 3 we know when under-cladding layer thickness is 5μm the radiation loss should be lower than 0.03dB/cm. So we proposed to make under-cladding layer thickness be 5, lower than 0.1dB/cm propagation loss is expected.

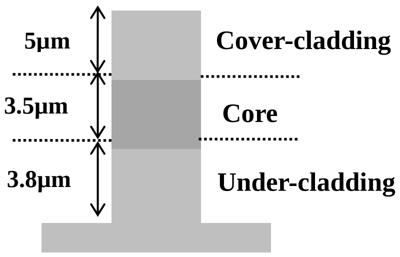

Fig. 1. Schematic of Silica high-mesa waveguide cross section.

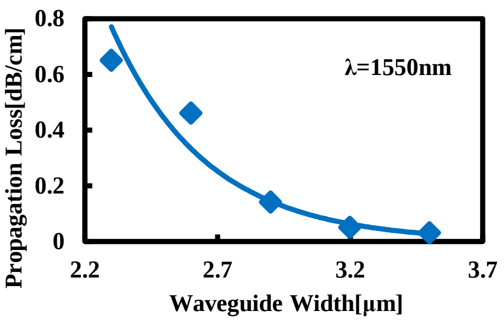

Fig. 2. Propagation loss as a function of waveguide width.

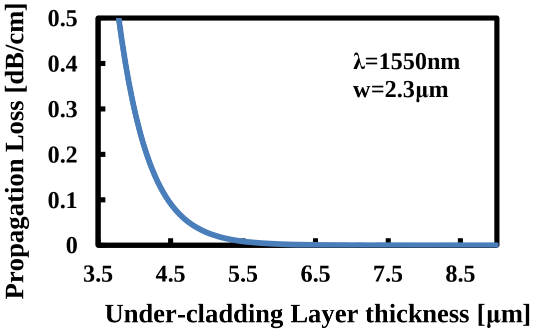

Fig. 3. Propagation loss as a function of under-cladding layer thickness.

References:

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[3] S. Yano, etc, IEICE Techn. Rep. OPE 2006-96, pp. 27, 2006.