Scattering loss analysis of high-mesa waveguide for waveguide gas-cell

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As the population aging wide spread across the world, old people daily health check is a serious problem. Breath analysis is a very attractive tool because it is a noninvasive way to monitor a patient’s physiological status [1]. The breath analysis glass gas cell is very large at the current situation which is not readily for daily use. Therefore, we are working on replacing the glass cell by high mesa waveguide type gas cell (see Fig.1) for miniaturization. As far as we know this is the first time that waveguide type gas cell is used around the world. High mesa waveguide can provide a part of optical field profiles out of the waveguide, which makes this sensor possible to realize [2]. One critical issue is the scattering loss of high mesa waveguide since huge amount of loss decrease the sensitivity of sensor [3], for our case, the scattering loss is the main loss. Scattering loss is due to the imperfection along the waveguide side wall (see Fig. 2). This imperfection is the damage from the etching process which is unavoidable. So how to decrease the scattering loss is very important for realizing this breath analysis system. Low propagation loss of 0.9dB/cm has been demonstrated so far by using NLD method and others [4]. However, further loss reduction is necessary to obtain higher sensitivity. The main work here is to find the methods to decrease the scattering loss theoretically. We found that using mid-infrared light (3.3μm), thicker core thickness (280nm) and width deviation reduction are all promising ways to decrease the scattering loss, as shown in Fig.3. If we choose proper parameter the scattering loss can be decreased to 0.05dB/cm.

![Fig.1 Schematic of high mesa waveguide](image1)

![Fig. 2 Schematic of rough high mesa waveguide. Top view of rough high mesa waveguide.](image2)

![Fig.3, Scattering loss dependency in optical wavelength, core thickness and width deviation.](image3)

Reference