Fabrication of Silica-Based Optical Waveguide Devices and Their Fiber Packages

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ABSTRACT

The successful development of optical networks toward fiberto home system will require development of low cost passive optical branching components. At present, commercially-available components are expensive, bulky, and have inconsistent performance. Silica-on-silicon integrated optics technology is well suited to fabrication of such device. In this thesis, single-mode Ge or Ti doped silica glass waveguide have been formed on Si wafer by flame hydrolysis deposition. The fabrication process is reproducible and produces waveguide with a loss < 0.1dB/cm at a wavelength 1.3 μ m. The maximum ⊿n achieved are 0.8% and 0.5% for Ge doped and Ti doped waveguide respectively. Besides, a new method of automatically coupling between fiber and an optical waveguide is disclosed. A key feature of this technology is that V-grooves for holding the input and output fibers can be precisely defined in silicon substrate as part of the waveguide fabrication, allowing passive fiber to waveguide alignment, leading to low cost device assembly and rugged fiber to waveguide coupling. The etched depth for opening V-groove window was minimized to be about 7 μ m in this method. Alternatively, such a process also reveals high reproducibility. By this invention, the alignment time of fiber-to-waveguide is saved to 1/30 of conventional active alignment. In addition, another invention relative to methods for fabricating glass diaphragm on a silicon microstructure was proposed. More specially, the present invention relates to methods for fabricating glass diaphragms and/or diaphragm-sealed chambers for use in microelectromechanical systems (MEMS), such as pressure transducers, microvalves, accelerometers, shear-stress sensors, etc. We fabricated several types of single mode S-band based 1*N splitters using above technology. By cascading simple 1*2 S- band splitters, 1*4 and 1*8 circuits were fabricated. For an active alignment packaged 1*8 splitter, average insertion loss of ＜11.5 dB was obtained with a uniformity of ＜1dB. For a passive alignment packaged single channel waveguide, average insertion loss of 2.8 dB of a 2cm long waveguide with an uniformity of 1.2 dB were obtained. Although this performance is not good, a further improvement is possible by optimizing the fabrication parameter and process. A coupling loss of below 1dB is expectant.

Keywords : Planar light wave circuit ; Flame hydrolysis deposition ; Passive alignment ; Silica-based glass ; Fiber-to-waveguide package ; Micro machining

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