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Micromechanical Mach-Zehnder Interferometer Compatible with Silicon Integrated Circuit and Micromachining Technologies

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Antiresonant reflecting optical waveguides (ARROW's) with optical propagation losses of 1 dB/cm, based on materials compatible with silicon integrated circuit (IC) and micromachining technologies, have been fabricated. Application of the above ARROW to optomechanical sensing is presented along with optimized configurations for high sensitivity to mechanical measurands.

1. Introduction

The advances in photonics technology coupled with progress made in silicon integrated circuit (IC) and, more recently, micromechanics technologies, can potentially spawn a new generation of miniaturized optical sensing devices and systems. Sensing using silicon integrated optics offers the benefits of both optics and IC technologies.[1] Examples include the fully guided pressure-sensitive Mach-Zehnder (M-Z) interferometer based on stress-induced modulation of the refractive index.[2-4] Incompatibilities with silicon IC technology and/or optical fibers can be overcome with the ARROW[5] which also allows the integration of photodetectors and subsequent signal processing electronics on the same chip.

In this paper, we present an ARROW that utilizes the standard IC technology dielectric materials that are also compatible with the silicon micromachining process (see Fig. 1). The latter feature is crucial for realization of optomechanical sensors as well as for improved coupling to the optical fiber. Sensitivity to mechanical measurands is achieved by anisotropic etching of the silicon substrate underlying the sensor arm. The fabrication