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APPLICATION OF MICROMACHINING TECHNIQUES FOR FABRY-PEROT CAVITY BASED MICROSENSORS

by

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APPLICATION OF MICROMACHINING TECHNIQUES FOR FABRY-PEROT CAVITY BASED MICROSENSORS

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Dedicated to my parents, two sisters and

my wife, Jihyung

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APPLICATION OF MICROMACHINING TECHNIQUES FOR FABRY-PEROT CAVITY BASED MICROSENSORS

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A micromachined Fabry-Perot cavity based sensor has been studied. The study consists of a discussion on a new fabrication technique for the sensor and a manufacturability design study of the sensor. The new fabrication technique allows a Fabry-Perot cavity sensor to be monolithically fabricated without using a wafer bonding process. Using this technique high manufacturing yield and better performance should be possible. The Fabry-Perot cavity sensor, combined with a multimode optical fiber, was also used to measure differential pressure. Measured optical response of the cavity has been compared with the simulated response that takes into account the averaging effect caused by the shape of the deflected mirror.

In addition to the development of a new fabrication technique, a design study for manufacture of Fabry-Perot cavity sensors has been performed where thickness variation of layers in the cavity exists. An analytic method has been developed which can efficiently calculate the variation of optical response due to thickness variation of layers. From the calculation, uncertainty in cavity gap due to process-induced variations has been obtained. This uncertainty bounds the accuracy of manufactured sensors. As another error source, fitting function-induced errors were also included in the calculation for the accuracy of the sensors. To find an optimum design, accuracy contour maps have been generated over the design space, i.e., initial cavity gap and mechanical travel of a moving mirror. Through this study it is shown that there exists an optimum design which gives high yield with a specific level of performance.

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