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Surface-Micromachined Microdiaphragm Pressure Sensors

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A microdiaphragm pressure sensor with a silicon nitride diaphragm of 100 μm diameter has been developed using surface micromachining (type-C). To increase the yield in the diaphragm formation process, the generation of hydrogen bubbles is greatly reduced by eliminating the anisotropic etching process of the silicon substrate and adopting a flat vacuum chamber fabricated by undercut etching of a polysilicon sacrificial layer. Sacrificial layer etching is carried out in concentric circles around a central etch hole to reduce the stress concentration in the etching process. A tetramethyl ammonium hydroxide solution having compatibility with the LSI process is utilized as an etchant for polysilicon sacrificial etching. The arrangement of the polysilicon piezoresistors is determined according to the stress analysis using a finite-element method. The yield of the diaphragm-forming process is greatly improved to more than 70%. The pressure sensitivity of approximately 10 μV/V/kPa is obtained, which is five times that of the conventional microdiaphragm pressure sensor (type-V).

1. Introduction

Currently, micromachining is expected to contribute to the development of new functional sensors and actuators. In silicon pressure sensors, the diaphragm size has become smaller year by year.[1-3] In particular, with the use of surface micromachining, pressure sensors of micron scale have been realized.[4,5] The adoption of the surface-micromachined pressure sensor can eliminate the cumbersome alignment steps