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Surface Micromachined Physical Sensors

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Surface micromachining with polysilicon, silicon nitride and oxide has achieved the status of a mature technology with product applications. This is in part due to the fact that a stable data base for the mechanical properties of these deposited films has been achieved. This data base allows successful computer-aided design and manufacturing of devices such as pressure transducers. Pressure ranges from 10 psia to 8000 psia have been achieved for the classic sealed pillbox piezoresistive transduction approach.

The extension of this pressure range to lower pressures requires stress transductions with higher sensitivity than piezoresistive techniques. A very promising alternative is a resonating clamped-clamped beam in a vacuum shell. This all-silicon structure has been fabricated and has produced remarkable results. Perhaps the most important attributes are: long-term stabilities of less than 1 ppm/month and acceptable, predictable temperature behavior. Quality factors above 60,000 have been achieved with input drives of less than 1 millivolt and input power near 10^{-14} watts. Acceptable size, quasi-digital output and reasonable manufacturing cost justify further research in improved versions of this axial force transducer.

1. Introduction

Sensors, or more precisely, sensor systems are found in an ever-increasing number of applications. This dynamic situation has resulted in new and modified