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Thermal Vacuum Sensor by CMOS IC Technology and Sacrificial Metal Etching

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We demonstrate a novel thermal vacuum microsensor fabricated by a commercial CMOS IC process followed by a sacrificial aluminum etching step. The device is exceptionally small (100 μm by 100 μm) compared with conventional vacuum sensors. Its sensitivity range is 10 to 10^5 Pa. In contrast to previous approaches, no removal of bulk silicon is required.

1. Introduction

Miniaturized thermal vacuum sensors (1.4 mm^2) have been made by bulk micromachining of silicon.[1,2] Improved thermal insulation and reduced size have been achieved using silicon oxide/nitride bridges[3,4] and cantilevers.[5,6] The latter vacuum microsensors are made by commercial CMOS IC technology combined with silicon etching using EDP.[7,8] These devices, however, are unsatisfactory from several points of view. First, in view of the fragile nature of their micromachined parts, they do not satisfactorily fulfill the requirement of mechanical robustness. Secondly, their layout design violates specific design rules of standard IC processes. Finally, the technique of selective silicon removal used to fabricate these structures clearly goes beyond standard IC technology.

We report a new thermal vacuum sensor that overcomes these disadvantages. Its design layout conforms to the entire set of CMOS IC design rules. The device was fabricated by a commercial CMOS IC technology, the 1.2 μm CMOS IC process of AMS (Austria Mikro Systeme, Unterpremstätten, Austria), and subsequently postprocessed by a simple procedure. The two postprocessing steps involved, photolithography and wet metal etching, are