

Accepted Manuscript

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Authors: Rongyan Chuai, Yuxin Yang, Xin Li, Jian Wang, Bing Zhang



PII: S0924-4247(18)30394-7
DOI: <https://doi.org/10.1016/j.sna.2018.07.008>
Reference: SNA 10873

To appear in: *Sensors and Actuators A*

Received date: 5-3-2018
Revised date: 31-5-2018
Accepted date: 1-7-2018

Please cite this article as: Chuai R, Yang Y, Li X, Wang J, Zhang B, Technical Method of Improving Overload of Pressure Sensitive Chip Based on Sacrificial Layer Technology, *Sensors and Actuators: A. Physical* (2018), <https://doi.org/10.1016/j.sna.2018.07.008>

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Technical Method of Improving Overload of Pressure Sensitive Chip Based on Sacrificial Layer Technology

Rongyan Chuai ^a, Yuxin Yang ^{a,*}, Xin Li ^a, Jian Wang ^b, Bing Zhang ^a

^a School of Information Science and Engineering, Shenyang University of Technology, Shenyang 110870, China

^b School of Information and Engineering, Shenyang University of Chemical Technology, Shenyang 110142, China

* Correspondence: m_123VIP@163.com; Tel.: +86-024-2549-6398

Highlights

- A design method in improving overload capacity of the pressure sensor is proposed.
- Relationship between the fracture strength of the polysilicon film and its thickness is provided, then the relationship between sizes of the sensitive structure and the overload capacity is elaborated.
- The simulation and analysis indicate that the overpressure can reach up to thirty one-fold of the full scale pressure.
- The overpressure of a sample pressure sensor chip is about 18MPa, which is 9 times of the full scale pressure. On the premise of ensuring the linear response of the sensor, the validity of design method improving the overload capacity is verified.

Received 5 March 2018, Received in revised form 31 May 2018

Abstract: For pressure sensitive chips made by sacrificial layer technology, their overload capacity can be significantly improved through accurate control over the thickness of the sacrificial layer and the pressure sensitive diaphragm. Based on the analysis for the simulation of the stress distribution of the pressure sensitive structure, the relationship between sizes of the sensitive structure and the overload capacity is elaborated in virtue of the influence of sensitive structure sizes on fracture strength of the polysilicon sensitive diaphragm; and then a design method in improving overload capacity is proposed. Our simulation and analysis indicate that the overload can exceed thirty one-fold of the full scale pressure when properly reducing the thickness of the sacrificial layer and the diaphragm. A sample pressure sensor chip is fabricated with a full scale range of 2MPa. The test results show that the overpressure of the sample is 18MPa, and its full scale output voltage is 288mV under 5V power supply.

Keywords: pressure sensor; overload capacity; fracture strength; piezoresistor

1. Introduction

Piezoresistive pressure sensors are one of the most successful MEMS sensors in history. They dominate in modern industry, and have been widely used in automotive electronics, process industry, as well as in medical and consumer products [1]. In particular, with the

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