Fabrication of Microcantilever Based Sensor

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1. Introduction

One of the most flexible mechanical sensor systems is the microcantilever based sensor. By reducing the dimensions of the sensor to the nanometer scale, the sensor can become faster, cheaper and more sensitive. Differential stress at the surface to the beam of the cantilever causes the bending of cantilever. The cantilever bending can be detected by different read-out methods, such as optical reflection, piezoresistive, Interferometric, piezoelectric and capacitive. In this work the direct electrical detection is used, which has an advantage of reduced complexity. Main objective towards this project is to demonstrate the application of Micro-cantilever as a temperature sensor. The design of the device is based on electrostatic actuation of a vertically deflecting cantilever and the readout method employed is electrical i.e current is used to detect the temperature. Fabrication of single layer Aluminium, Polysilicon and bi-layer cantilever (Polysilicon-Gold) and thorough electrical characterization of these sensors was done to verify the functionality of the sensor.

2. Fabrication Of Microcantilever

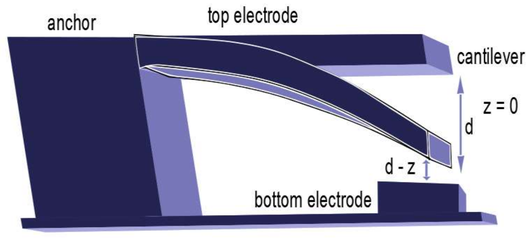


Fig. 1. Microcantilever based sensor with bottom electrode

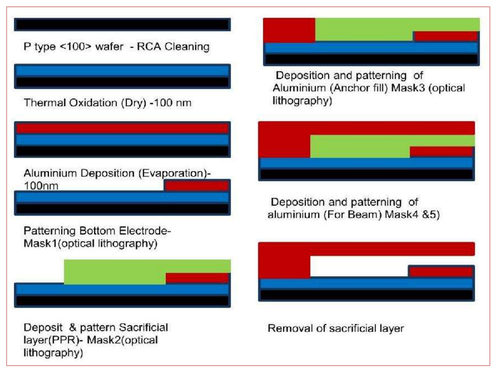


Fig. 2. Schematic stepwise process flow

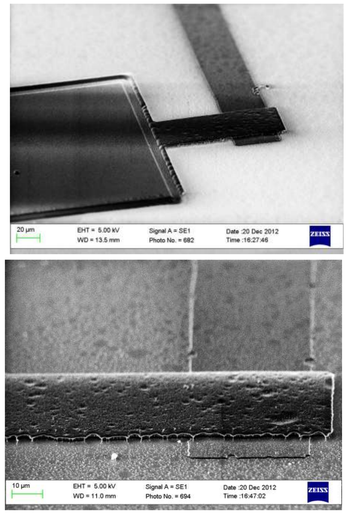


Fig. 3. Resist removed after evaporation of acetone

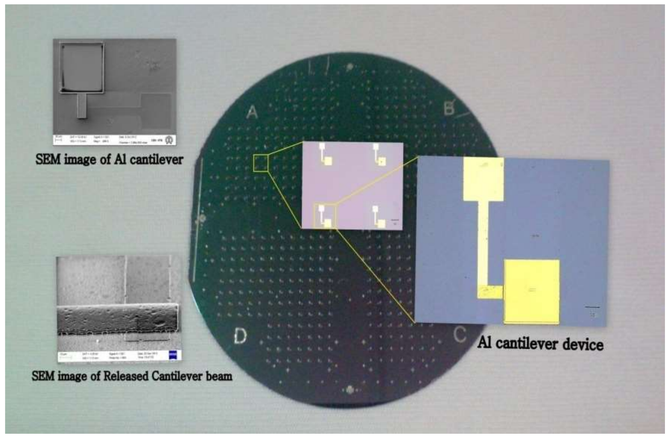


Fig. 4. Photograph of Fabricated microcantilevers after optimization process

3. Electrical Characterization

Electrical characterization experiments are performed on the fabricated device. Electrical characterization set up was used for testing and measurement of microcantilever. The following characterizations were done:

1. Current-Voltage (I-V) Characterization
2. Experiments for temperature detection
3. Transient Analysis of Microcantilever Based Sensor

Fig. 5. Electrical characterization setup

4. Experimental Results For Single Layer And Bi-Layer Cantilevers

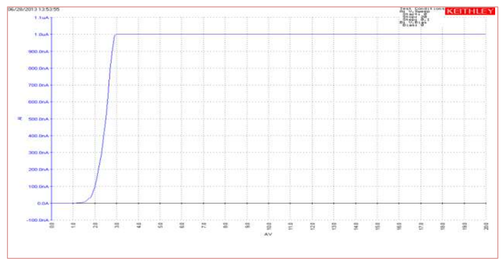


Fig. 6. I-V Characterization of single layer

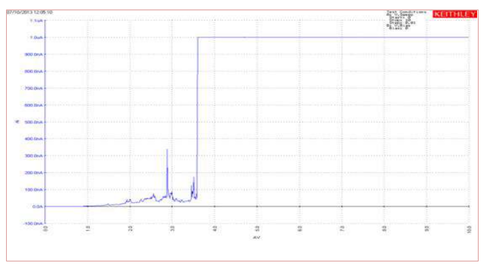
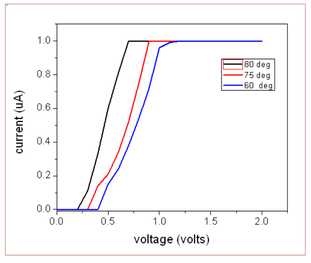
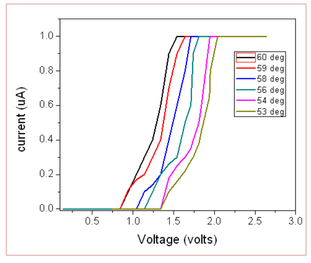


Fig. 7. I-V Characterization of Bi-layer Structure



(a)



(b)

Fig. 8. Temperature dependent I-V Characterization of (a) single layer structure and (b) bi – layer structure

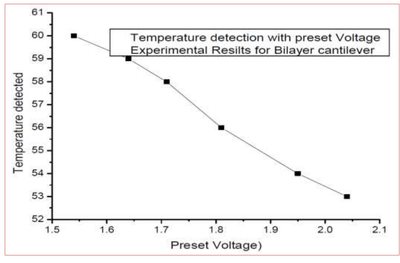


Fig. 9. Temperature detected at various preset voltage levels

Conclusion

In this work microcantilever sensors with electrical readout method has been designed and developed. Electrical characterization of these microcantilevers was performed. The device was prestressed with the voltage and different temperatures could be detected. Experimental results are validating the use of the microcantilever for temperature detection. The operating range for temperature sensing application is improved in bi-layer structure which is experimentally demonstrated.

PG students Associated: Mr. Aditya Dhanvijay, Ms. Priya Borkar

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